Food for thought

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ISBN: 978-90-367-5160-5
Cover design: Darko en Ridderprint
Printed by Ridderprint

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The role of food-related cognitive motivational mechanism in dysfunctional eating

RIJKSUNIVERSITEIT GRONINGEN

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The role of food-related cognitive-motivational mechanisms in dysfunctional eating

Proefschrift

ter verkrijging van het doctoraat in de
Gedrags- en Maatschappijwetenschappen
aan de Rijksuniversiteit Groningen
op gezag van de
Rector Magnificus, dr. E. Sterken,
in het openbaar te verdedigen op
maandag 28 november 2011
om 14.30 uur

door

Esther Marie Veenstra-Wijnen
geboren op 7 oktober 1982
te Eindhoven

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Chapter 1

General introduction

Introduction and background

Why do some people succeed to manage their food intake and why do some people struggle to manage their food intake? This is the central question of this thesis.

The Netherlands Nutrition Centre Foundation provides information on healthy and safe food. They encourage consumers to develop and maintain a healthy eating pattern, and recommend around 2000 calories a day for women and 2500 for men (Voedingscentrum, 2011). However, many people do not succeed in the management of a healthy eating pattern and eventually become overweight. Every year, Statistics Netherlands investigates how many people are overweight in the Netherlands. Overweight can be defined by the Body Mass Index (BMI; weight/height^2). A person is overweight from a BMI of 25, and when a person has a BMI of 30 or higher, it is called severe overweight or obesity. Whereas in 1981 41% of men and 36% of women were (severe) overweight, in 2009 these percentages were increased to 64% in men and 54% in women (Swinkels, 2011). Apparently, many people struggle to maintain a healthy eating pattern.

Problems with managing a healthy eating pattern can also result in normal weight or underweight. People diagnosed with Boulimia Nervosa (BN) are characterized by compensating periods of excessive overeating (i.e., binges). BN patients compensate by purging, extreme dieting or excessive exercising and end up with normal weight. The average prevalence of BN is 1,0% (Hoek, 2006). Whereas many people have difficulties eating not too much, a small group exceeds in strictly regulating their food intake, however, in a destructive manner. People diagnosed with Anorexia Nervosa (AN) are characterized by a successful restriction of their eating pattern, resulting in severe underweight. AN patients have strict dieting rules, that are inflexible in nature (e.g., maximum of 600 kcals a day). Despite their low weight, AN patients are characterized by an intense fear to gain weight. Furthermore, many AN patients additionally engage in excessive exercising to lose weight (Fairburn, 2008). The average prevalence rate of AN is only 0,3% (Hoek, 2006), however, AN is associated with the highest mortality risk among all mental disorders (Harris & Barraclough, 1998), about 5 - 15% of all AN patients eventually die from the consequences of their eating disorder (Hoek, 2006; Huas et al., 2011).

Cognitive Behavioral Theory of Eating Disorders

Patients with eating disorders (e.g., AN, BN) are characterized by high concerns about eating, weight, and their body shape. They tend to evaluate themselves by assessing their weight and shape. More specifically, according to the cognitive-behavioral theory of eating disorders, patients with eating disorders are characterized by self-schemata that relate to body shape and eating (Williamson et al., 2004). Weight- and food-related schemata are cognitive structures that process information about the *meaning* of being fat or thin and the *meaning* of eating high-fat food. In these self-schemata constructs of weight and food are connected to constructs like self-control and self-worth (e.g., 'if I eat chocolate, I am out of control' or 'if I am fat, people will disapprove me'). In this way, weight- and food-related information do have implications for the self, and could influence thoughts, affect, and behavior (Vitousek & Hollon, 1990), like obsessional counting of calories, anxiety, and body checking behavior, respectively. Additionally, weight- and food-related schemata could influence perception of weight- and food-related information. Attention for weight-, and food-related material could be biased, but also more motivational mechanisms like automatic associations with and motivational orientation towards weight-, and food-related material could be biased (compared to neutral information). The cognitive theory of eating disorders postulates that concerns about body shape and eating lead to erroneous information processing of body size/shape and food-related information which in turn contributes to a dysfunctional eating pattern and overconcern about body shape and weight. In this biased information processing, self-schemata about body shape and eating are presumed to direct a person's attention towards body shape and eating-related information. Furthermore, interpretations of body shape and eating-related information of self-relevant events become biased as this information is interpreted in favor of self-schemata (e.g., fatness) of the individual (Williamson et al., 2004). For example, when an AN-patient would dislike high-fat food on an unconscious level, this would be helpful for her self-schema about food as it supports her restricting eating behavior, and in turn her feelings of fatness. So, changes in cognitive-motivational mechanisms could affect self-schemata and maintain dysfunctional eating behavior.

Cognitive-motivational mechanisms and disturbed eating behavior

Thus several cognitive-motivational mechanisms have been implied in the cognitive models of eating disorder. This thesis focuses on three of these mechanisms that seem all promising in helping to explain the unique ability of AN patients to successfully regulate their food intake, as well as the unsuccessful regulation of food intake as seen in overeaters: automatic approach-avoidance tendencies, automatic affect, and attentional bias. Each of these mechanisms will be subsequently considered/discussed in the following paragraphs.

Automatic motivational orientation and automatic affective 'liking' associations

Some theorists have argued that both automatic approach tendencies (motivational orientation or behavioral response of approach/avoidance) and affective associations with food (positive/negative valence or liking/disliking) play a role in the regulation of food intake. They argue, however, that approach tendencies and affective evaluations of food are basic adaptive mechanisms that could not be disturbed in pathological eating behavior. When a person has a goal of weight control and thus of restricting food intake, there would still also be this basic adaptive goal to eat for survival or pleasure (goal-conflict model of eating, Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). Following this view, food deprivation (also in AN patients) will promote automatic approach tendencies toward food, and the ability of AN patients to refrain from food would be an expression of their superior self-control (e.g., Seibt, Häfner, & Deutsch, 2007).

On the other hand, the incentive-sensitization theory suggests that motivational and affective processes could well be involved in pathological eating behavior, and proposes that dysfunctional eating patterns might be the result of (de)sensitized motivational processes of food reward. According to this neurocognitive view, the process of food reward consists of two distinct processes, that are called 'wanting' and 'liking'. 'Liking' refers to the hedonic aspects of food, like the pleasure and palatability of food, and is an affective state. 'Wanting' refers to craving, appetite or the predisposition to eat, and is more a motivational state. These processes are represented by different brain substrates. During the incentive salience attribution process (i.e., numerous food intakes that are experienced as rewarding), food stimuli become especially attractive and wanted. In other words, this theory suggests that food elicits neural and psychological representations (i.e., schemata), that are obtained through repeatedly rewarding experiences, which may enhance the motivational saliency of these food stimuli. Because of their enhanced motivational saliency these stimuli are assumed to grab and hold attention, will be perceived as attractive, and become wanted (Berridge, 1996; Berridge, 2007; Robinson & Berridge, 2001). This incentive-salience process is associated with subjective experience of craving, which will logically lower the threshold for actual food intake. Following this neurocognitive view, dysfunctional eating patterns might thus be the result of (de)sensitized motivational processes of food reward. *Sensitized* motivational orientation towards food would logically interfere with attempts to regulate food intake and would therefore be especially relevant in the context of overeating. *Desensitized* motivational orientation, (i.e., food intakes are assessed as unrewarding which will logically lower motivational salience of food), on the other hand, would be helpful to restrict people's food intake and might therefore help to explain how restricting AN patients succeed in regulating their food intake. Additionally, changes in the hedonic aspects or affective associations with food could possibly (independently) contribute to a dysfunctional eating pattern. Then, negative affective associations (i.e., disliking food) could help explain successful regulation and more positive affective associations (i.e., liking food) could help explain an unsuccessful regulation of food intake.

Similar to the neurocognitive model of food reward, current dual process models, like the Reflective-Impulsive Model (RIM; Deutsch & Strack, 2006; Strack & Deutsch, 2004) suggest that both approach tendencies and affective processes jointly influence behavior. Following the RIM, there are two cognitive systems. The first system is slow and deliberate (reflective), and operates on a conscious level. The other system is fast and efficient (impulsive), and operates on a more unconscious level that is not readily accessible to introspection. In the impulsive system, both affective associations (e.g., liking food) and relatively spontaneous approach/avoidance behaviors towards food guide actual eating behavior. The relevant motivational and affective processes might well be distinct from subjective awareness, and should not only be measured by self-report measures. Moreover, the registration of food reward processes by subjective reports could easily be biased, as factors like social desirability may influence these direct, reflective measures. Therefore, it seems important to complement these self-reports with more indirect performance measures that are sensitive to more automatic, uncontrollable processes (Fazio & Olson, 2003). Thus, the relevant motivational processes could be reflected in subjective reports of appetite for food, but would especially be identifiable in automatic approach/avoidance behaviors for food. Equally, the relevant affective processes could be reflected in self-reports of liking food, but would especially be identifiable in automatic affective associations with food. To explore the role of both processes, both automatic motivational orientation towards food and automatic liking associations with food were investigated in this thesis, and their potential role in pathological eating behavior is discussed in the next paragraphs.

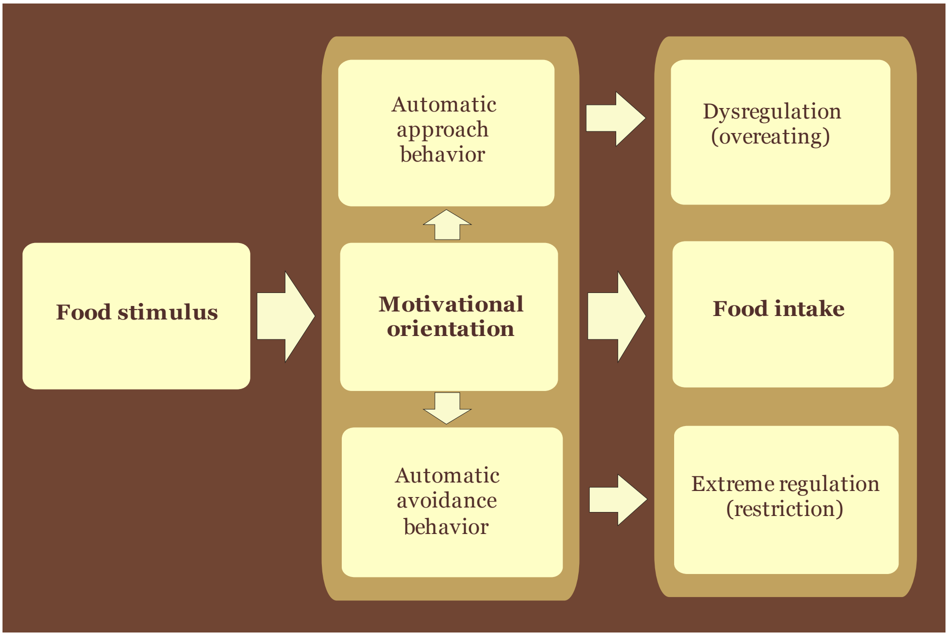

Figure 1.1: Specific hypothesis on the role of motivational orientation towards food in the successful and unsuccessful restriction of food intake. A food stimulus could elicit automatic approach or avoidance behavior towards food which could contribute to dysregulation of eating behavior as seen in overeating, and the extreme restriction as seen in AN, respectively.

Approach tendencies ('wanting'). Automatic motivational orientation towards food could thus be involved in pathological eating behavior, and the hypothesized role of automatic approach tendencies towards food is presented in Figure 1.1. Overeaters might show enhanced automatic approach tendencies towards food compared to normal eaters, which could hinder them to regulate their eating pattern. The opposite pattern might be involved in restricting AN patients. AN patients might demonstrate *reduced* automatic motivational orientation or even avoidance of food. If so, this would help them to restrict their food intake. However, it could also be that overeaters and AN patients show no differences in their automatic motivational orientation of food, and their dysfunctional eating behavior could rather be explained by more deliberate processes, which could be identifiable in more explicit strategies like subjective reports of craving for food. Despite 'normal' approach tendencies towards food, overeaters would then have a dysfunctional explicit strategy to resist food, whereas AN patients would have superior strategies to resist food on a more conscious/intentional level.

To date, there are only few studies that examined automatic approach tendencies for food. One of these studies specifically focused on the role of approach tendencies in overeating. Using a stimulus-response compatibility (SRC) computer task, this study showed stronger approach tendencies for food in overeaters than in normal eaters (Brignell, et al., 2009). Research on motivational orientation towards food in AN patients is still an undeveloped area. Only one study focused on approach tendencies in eating-disordered patients. This study in the context of food deprivation showed no differences in approach tendencies towards food between eating-disordered patients and healthy controls (Seibt, Häfner, & Deutsch, 2007). However, this study was conducted in a relatively small sample of eating-disordered patients comprising of both patients with AN and BN, which renders these results difficult to interpret.

Automatic affective associations with food ('liking'). Automatic affective associations might also be involved in pathological eating behavior, and the hypothesized role of these automatic 'liking' associations with food is presented in Figure 1.2. Overeaters might show stronger automatic liking associations with food compared to normal eaters. AN patients, however, might demonstrate weaker automatic liking associations with food that could help them to restrict their food intake. So, on an automatic level, food could be evaluated more positively in overeaters and/or negatively in restricting anorexia nervosa. However, it could also be that overeaters and AN patients show no differences in processing of food information. Then, dysfunctional eating behavior of AN-patients could rather be explained by more deliberate processes, which could be identifiable in more explicit strategies like subjective reports of liking food.

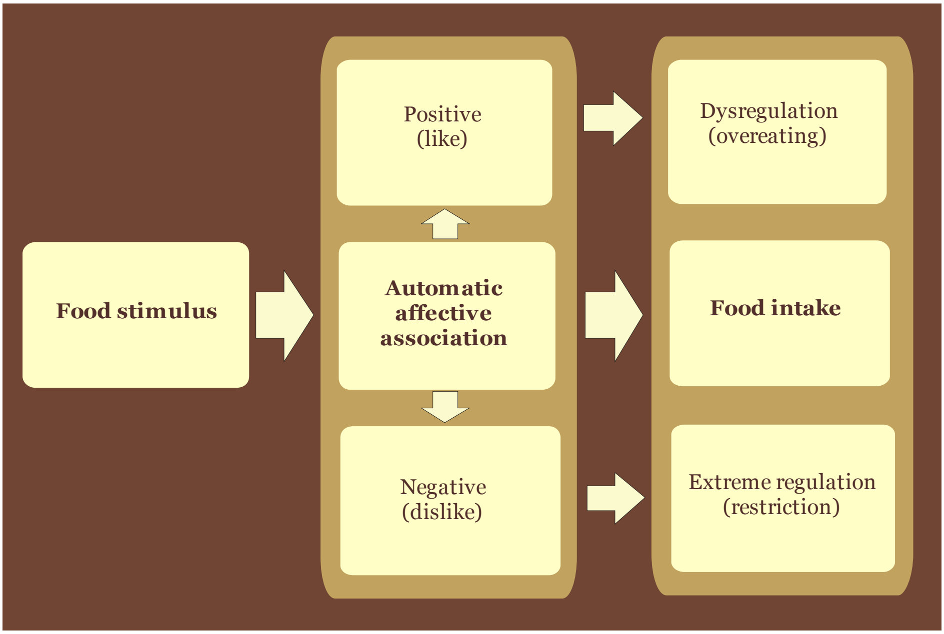

Figure 1.2: Specific hypothesis on the role of automatic affective associations with food in the successful and unsuccessful restriction of food intake. A food stimulus could elicit automatic 'like' or 'dislike' evaluations towards food which could contribute to dysregulation of eating behavior as seen in overeating, and the extreme restriction as seen in AN, respectively.

A considerable amount of research has already been conducted to measure automatic affective associations with food in overeaters using indirect measures. These studies, however, did not reveal consistent results (Roefs et al., 2011). Some studies found stronger positive associations with high-fat food in overeaters (Craeynest et al., 2005; Papies, Stroebe, & Aarts, 2007; Hoefling & Strack, 2008), but even more studies failed to find stronger positive associations with high-fat food in overeaters compared to a control group (Roefs & Jansen, 2002; see also Maison, Greenwald, & Bruin, 2001; Roefs, Herman, MacLeod, Smulders, & Jansen, 2005a; Roefs et al., 2005b; Vartanian, Polivy, & Herman, 2004). For example, in a study using the Implicit Association Task (IAT; Greenwald, McGhee, & Schwartz, 1998), obese people showed even stronger negative associations with high-fat food than normal-weight controls (Roefs & Jansen, 2002).

These inconsistent results could of course imply that automatic affect is not so much involved in dysfunctional eating behavior. However, the lack of straightforward results might perhaps also be due to some of the methodological features of these previous studies. Perhaps most important, in these earlier studies, participants had to categorize food stimuli on a positive/negative or on a high-fat food/low-fat food dimension rather than on a tasty/untasty dimension. This approach might have generated evaluations based on health concerns rather than liking associations with food (cf., Roefs et al., 2005b). To reach more final conclusions regarding the relevance of automatic liking associations in dysfunctional eating behavior, it would therefore be important to use a relevant response feature that unambiguously refers to the palatability and/or the pleasurability of food.

Attentional bias

As noticed earlier, a person has to detect the food stimulus before food can be perceived as attractive or wanted. These attentional processes could also be biased, which result for instance in early detection (i.e., vigilance) and/or maintained attention for the stimulus. Differentially attending towards emotional information compared to neutral information is called attentional bias. Attentional bias for motivationally salient reward-related (drug) stimuli has repeatedly been found (e.g., opiate dependence, Lubman, Peters, Mogg, Bradley, & Deakin, 2000; e.g., smoking, Mogg, Bradley, Field, & De Houwer, 2003). Similar to the neurocognitive model of food reward, theories in drug addiction propose that attractive information captures attention, hold attention, and subsequently elicit approach behaviors. Furthermore, these approaches assume a reciprocal relationship between craving and attentional bias (Franken, 2003). In line with this view, it has even been argued that the development of attentional bias for drug stimuli may be the core process underlying craving and compulsive-drug-use (Lubman et al., 2000). Similar to studies in addiction, attentional bias for food could play a role in the dysregulation of eating behavior. Both enhanced attentional engagement of food stimuli and a difficulty to disengage might lower the threshold for the generation of craving for (forbidden) foods. Opposite processes (i.e., attentional avoidance) might be involved in AN patients, which might help them to prevent feelings of craving and to restrict their food intake.

Previous studies on attentional bias for food that used a visual probe strategy showed mixed results in (non-clinical) overeaters. One study demonstrated attentional avoidance from food when food cues were presented for 500 ms (Johansson, Ghaderi, & Andersson, 2004). Another study showed no differences in attentional biases between groups when food cues were presented for 500 ms, whereas in a 2000 ms presentation duration, attentional bias for food was found in overeaters (Brignell, Griffiths, Bradley, & Mogg, 2009).

Studies on attentional bias for food in eating-disordered patients showed that eating-disordered patients display attentional bias towards high-caloric eating pictures, whereas they direct attention away from low-caloric eating pictures compared to controls (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007; Smeets, Roefs, van Furth, & Jansen, 2008; Shafran, Lee, Cooper, Palmer, & Fairburn, 2008). These findings support the view that eating-disordered individuals are characterized by enhanced attentional bias towards 'forbidden' foods and are consistent with models implying that attentional bias towards high-fat foods may give rise to problems in the normal regulation of food intake. However, earlier studies on attentional bias for food considered different eating disorder diagnoses as different expressions of the same pathology and collapsed data of different diagnoses (or did not have enough power to reliably distinguish between diagnoses). Although this approach is consistent with the transdiagnostic theory of eating disorders (Fairburn, 2008), it is therefore still unclear whether these results also apply to AN, and how attentional bias for food might be involved in the successful restriction of food intake.

Furthermore, current definitions suggest that attentional bias consists of three critical components: initial shift of attention, attentional engagement, and attentional disengagement (Posner, 1980). Biases in all of these components may add to an individuals' preoccupation with food and may inadvertently influence the regulation of food intake. Further research on attentional bias for food in dysfunctional eating behavior is needed to gain insight in whether and how these specific components of attentional bias are involved in different types of dysfunctional eating behavior.

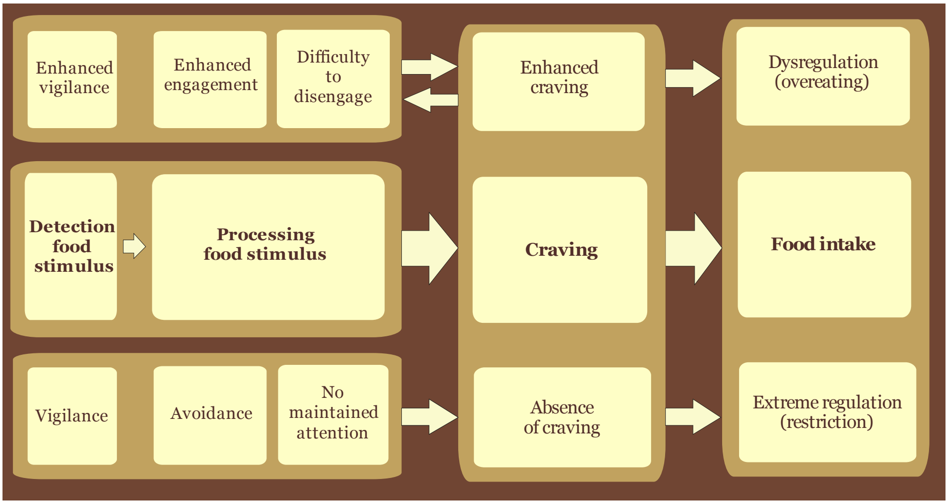

Figure 1.3: Specific hypothesis on the role of attentional bias for food in the successful and unsuccessful restriction of food intake. Selective attentional biases for food could contribute to dysregulation of eating behavior as seen in overeating, whereas a pattern of vigilance and avoidance could contribute to the extreme restriction as seen in AN.

Figure 1.3 shows the hypothesized role of attentional bias for food in dysfunctional eating. The middle line shows the 'normal' line in which a food stimulus is detected, processed, induces craving, and is eventually consumed. The upper line shows potential biases of attentional components in the dysregulation of eating behavior. In an early stage, enhanced vigilance helps the individual to detect the food stimulus, enhanced engagement adds to a profound processing of the food stimulus, and maintained attention hinders the individual to disengage attention from the food stimulus. All these biases may add to the level of craving, which then may eventually result in overconsumption or overeating. The lower line shows potential biases in the extreme regulation of eating behavior. Perhaps similar to attentional bias studies in phobic anxiety (e.g., Mogg, Bradley, Miles, & Dixon, 2004), AN patients may show a vigilance-avoidance pattern related to food items, in which vigilance for food contributes to detect food in an early stage combined with avoidance of thorough processing of food aspects, which may logically lower the level of craving or result in no craving at all, thereby helping them to subsequently avoid (the intake of) food.

Motivational orientation, automatic liking associations, and attentional bias

The three cognitive-motivational mechanisms described above (motivational orientation, automatic liking, attentional bias) could also be interrelated, and be involved in different stages over time. First, when a person encounters a food stimulus (i.e., smell or sight of food), the food stimulus is assumed to capture attention. The schematic content is activated and the stimulus is automatically evaluated in terms of like or dislike. Subsequently, the person holds attention or avoids (further) attentional engagement. When a person hold attention, approach tendencies might be elicited (motivational orientation), and subsequently subjective feelings of craving will arise and eventually food intake will follow. When a person shows attentional avoidance, processes of motivational orientation and craving will decrease, which would help a person to refrain from food intake.

Figure 1.4 illustrates presumed interrelationships between these factors and how they may jointly give rise to the dysregulation of food intake. *Arrow 1* reflects the hypothesized relation between affective associations with food and attentional bias. A positive ('like') evaluation of food could enhance attentional bias for food, whereas a negative ('dislike') evaluation of food could reduce attention for food or even result in attentional avoidance from food. *Arrow 2* reflects the hypothesized relation between affective evaluations and approach tendencies towards food. Positive evaluations of food could induce approach motivation, whereas negative evaluations of food could induce an avoidance motivation (cf., Chen & Bargh, 1999). Finally, *arrow 3* reflects the alleged reciprocal relationship between attentional bias and motivational orientation/craving (cf., Franken, 2003). In case of overeating, both processes may strengthen each other and result in overconsumption, whereas in case of undereating, absence of one process may prevent people to enter a positive feedback loop, thereby facilitating the restriction of food intake.

As a first step to test this model, this thesis focuses on these processes separately to see whether they individually add to disordered eating behavior, which is expressed in the model by the horizontal lines. When these cognitive-motivational mechanisms independently add to dysfunctional eating behavior, the next step will be to investigate the interrelationships between these processes.

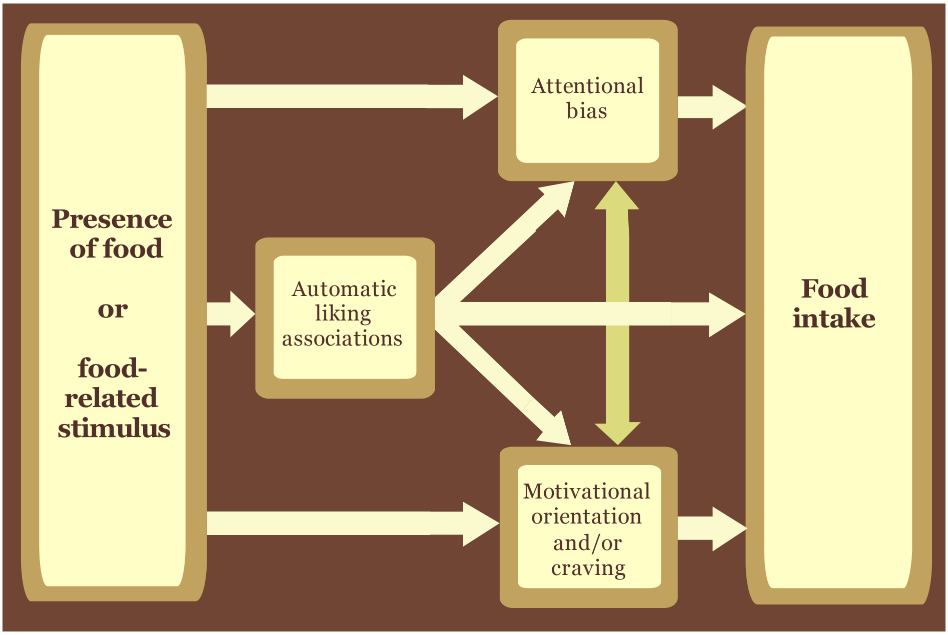

Figure 1.4: Heuristic model of cognitive-motivational mechanisms and their involvement in dysfunctional eating: potential independent contributions and interrelationships.

Outline thesis

The central question focuses on both unsuccessful and successful regulation of food intake. Therefore, two different types of samples were included this research. To study the unsuccessful regulation of food intake, a group of restrained and unrestrained eaters were investigated. Restrained eaters are characterized by a goal in which they try to limit their food intake. However, they often fail and engage in periods of overeating. Second, a group of restricting AN-like patients was investigated to assess the same processes in people who are extremely successful in strategically regulating their food intake. The thesis focuses on a subset of cognitive-motivational mechanisms that seems all promising in helping to improve our understanding of the processes that may be involved in the dysregulation and extreme regulation of food intake: Automatic motivational orientation towards food, automatic affective associations with food, and attentional bias for food. These relatively automatic processes are concurrently investigated with more deliberate processes that also may play a role in the development and/or maintenance of disordered eating patterns. Motivational orientation towards food and liking associations with food and their explicit proxies (i.e., craving for food and self-reported liking of food) may provide more information about the food reward system in healthy and disordered eating behavior. Attentional bias for food is investigated to gain insight in whether possible biased attentional processing of food may complicate an individual's food intake.

Chapter 2 focuses on motivational orientation and liking associations in restrained and unrestrained eaters to see whether motivational orientation towards food may indeed be involved in the dysregulation of food intake in overeaters. The role of explicit craving for food and liking food will also be clarified. Chapter 3 describes a study investigating the same processes but now in a group of restricting AN-like patients. This chapter focuses on the question whether absence of motivational orientation could play a role in the extreme regulation of food intake in restricting AN patients. Subsequently, a study on attentional bias for food in a group of restrained and unrestrained eaters is described in Chapter 4. Do overeaters show heightened attention for food, which could (partly) explain their struggle to manage their food intake? This study is also replicated in a group of restricting AN-like patients and this study is described in Chapter 5. This study focuses on the question whether a possible absence of attentional bias for food (or even attentional avoidance of food) is characteristic of restricting AN patients which could help them to manage their food intake so successfully.

Chapter 2

Restrained Eaters Show Enhanced Automatic Approach Tendencies Towards Food

E. M. Veenstra, P.J. de Jong

Appetite (2010, 55, 30-36)

Abstract

Although restrained eaters intend to limit their caloric intake, they nevertheless frequently fail and indulge in exactly the foods they want to avoid. Because automatic food-relevant approach tendencies and affective associations may both (independently) contribute to the dysregulation of food intake, the present study was designed to investigate the importance of both processes in relation to high-fat and low-fat food in restrained and unrestrained eaters. Both restrained and unrestrained eaters demonstrated stronger automatic liking associations with high-fat food than with low-fat food items, whereas a similar pattern was absent in their self-reports of liking food. Interestingly, specifically restrained eaters also displayed relatively strong automatic approach tendencies. These results appear to be consistent with the incentive-sensitization theory (Robinson & Berridge, 2001), as overeating seems not so much to be characterized by enhanced liking of food but by stronger automatic approach tendencies towards food.

Introduction

Although so-called restrained eaters (Herman & Polivy, 1980) intend to limit their caloric intake, they frequently fail and indulge in exactly the foods they want to avoid. Similarly, problems in regulating eating behavior are also characteristic for bulimia nervosa patients. Possibly, this conflicting behavior of dieting-overeating periods can be explained by disturbed processing of food-relevant information (cf. cognitive-behavioral model of eating disorders; Williamson et al., 2004).

In line with this, it has been proposed that perhaps enhanced positive automatic associations with high-fat food may complicate the restriction of food intake (e.g., Roefs & Jansen, 2002). Recent dual-process models such as the Reflective–Impulsive system Model (RIM; Strack & Deutsch, 2004; Deutsch & Strack, 2006) emphasize the importance to differentiate between more spontaneous, automatic and more deliberately activated attitudes and behaviors. Following the RIM there is a slow and deliberate (reflective) system, which operates on a conscious level. But there is also a fast and efficient (impulsive) system, which operates on a more unconscious level that is not readily accessible to introspection. In the impulsive system, affective associations are assumed to guide the execution of relatively spontaneous approach/avoidance behaviors. So, restrained eaters may have relatively strong positive automatic affective associations with high-fat food, whereas their explicit/deliberate evaluations of high-fat food are more negative. This dissociation might help explain their conflicting dieting-overeating pattern.

A considerable amount of research has already been conducted to measure automatic affective associations with food in overeaters (obese people and restrained eaters) using indirect measures. These studies, however, did not reveal consistent results (Roefs et al., 2011). Some studies displayed stronger positive associations with high-fat food in overeaters (Craeynest et al., 2005; Papies et al., 2007; Hoefling & Strack, 2008), but even more studies displayed no stronger positive associations with high-fat food in overeaters compared to a control group. For example, in a study using the implicit association task (IAT; Greenwald et al., 1998), obese people showed even stronger negative associations with high-fat food than normal-weight controls (Roefs & Jansen, 2002; see also Maison et al., 2001; Roefs et al., 2005a; Roefs et al., 2005b; Vartanian et al., 2004). In these earlier studies, participants had to categorize food stimuli on a positive/negative or a high-fat food/low-fat food dimension rather than on a tasty/untasty dimension. This approach may have generated evaluations based on health concerns rather than liking associations with food (Roefs et al., 2005b). To reach more final conclusions regarding the relevance of liking associations in overeating, it would therefore be important to use a relevant response feature that unambiguously refers to the palatability and/or the pleasurability of food. Therefore, the present study employed a measure of automatic affective associations using 'tasty' and 'untasty' as the relevant response options upon presentation of (high versus low-fat) food stimuli. More specifically, we used a pictorial Affective Simon Task (De Houwer & Eelen, 1998; De Houwer, Crombez, Baeyens, & Hermans, 2001), that has been shown to be sensitive to individual differences in automatic affective evaluations (e.g., Huijding & de Jong, 2005).

As a second factor that may complicate the restriction of food intake, we investigated individuals' automatic approach tendencies towards food (i.e., motivational orientation). Although approach tendencies are often used to infer positive affect (e.g., Brignell et al., 2009), several authors have argued that approach/avoidance tendencies and affective associations can be best considered as 'loosely coupled systems' implying that automatic approach tendencies and affective associations may not perfectly covary across all situations or may even diverge under certain conditions (e.g., Zinbarg, 1998). It could even be speculated that enhanced automatic approach tendencies for food particularly disturb the normal regulation of automatic affective associations with food in overeating, as approach behavior may play a role in attitude formation (Cacioppo, Priester, & Berntson, 1993). Germane to this suggestion, Berridge (1996) argues that sensitized motivational rather than affective processes of food reward might be most critical in explaining overeaters' difficulty in regulating their food intake. In his model these motivational processes are called 'wanting' and refer to craving, appetite or the predisposition to eat, that all seem reflected in (automatic) approach tendencies for food.

To date, there are only few studies that examined approach tendencies for food. One of these studies specifically focused on the role of approach tendencies in overeating. Using a stimulus-response compatibility (SRC) computer task, this study showed stronger approach tendencies for food in overeaters than in normal eaters (Brignell, Griffiths, Bradley & Mogg, 2009). In this SRC task, participants were instructed to move a manikin (i.e., small match stick figure) towards or away from pictures on the basis of food content (i.e., food-related or food-unrelated) using the arrow keys on the keyboard. By and large, overeaters were relatively fast when the required response was to move the manikin towards the food stimulus and relatively slow when the required response was to move the manikin away from the food stimulus. However, using the object of interest (i.e., food) as a task-relevant feature renders the SRC task sensitive to strategic influences. When in this task food is the task-relevant feature, participants are instructed to move the manikin towards food pictures and away from non-food pictures (or the other way around), with which participants may be more aware of the specific goals of the task. In the present study, we therefore employed an indirect version of this task, using the orientation of the stimulus (top or side view of the object on the picture) rather than food content as the task-relevant feature (cf. De Houwer et al., 2001). Thus, participants had to approach or avoid pictures depending on the orientation of the stimulus irrespectively of its (food) content. Using food as a task-irrelevant feature, with which the focus of the participant is not explicitly directed to the food content, will render the task less obtrusive and sensitive to strategic influences or habituation, and could therefore provide a better estimate of automatic approach tendencies for food (Rinck & Becker, 2007).

Because automatic food-relevant approach tendencies (motivational orientation) and affective associations (liking) may both (independently) contribute to the dysregulation of food intake, the present study was designed to investigate the importance of both processes in relation to high-fat and low-fat food in restrained and unrestrained eaters.

Method

Participants

As a proxy of overeaters, we selected restrained eaters and a group of unrestrained eaters by using the Restraint Scale (RS; Herman & Polivy, 1980). All first year female psychology students at the University of Groningen completed the RS. Participants were classified as restrained eaters (n = 28; Body Mass Index (kg/m^2): M = 24.5; SD = 4.3; range = 19.6 – 34.4), indicated by scoring in the highest quartile (RS ≥ 14).

Participants were classified as unrestrained eaters (n = 27; Body Mass Index: M = 20.8; SD = 2.0, range = 17.2 – 25.8), indicated by scoring in the lowest quartile (RS ≤ 7). The two groups did not differ significantly in age, $F(1, 54) = 2.48$, $p > .05$. However, they did differ in BMI, $F(1, 54) = 19.96$, $p < .001$.

Stimulus selection

Stimulus selection for the Affective Simon Tasks was based on a study on the evaluation of high-fat and low-fat foods (Roefs et al., 2005a). Pictorial stimuli were used, as pictures may provide a more ecologically valid representation of food than words, and pictorial stimuli are generally assumed to be more strongly related to affective information than words (De Houwer & Hermans, 1994). For both tasks, stimuli consisted of five high-fat food pictures (pizza, croissant, chocolate, crisps, and chips), five low-fat food pictures (strawberries, melon, grapes, popcorn, and chicken). Ten neutral pictures were based on or derived from the International Affective Picture System (IAPS; 1995). The IAPS numbers were 7002, 7004, 7006, 7009, 7010, 7035, 7175, and three pictures with similar objects as the IAPS pictures. Of every stimulus, three different pictures were constructed: one for the AST-voice-key, and two for the AST-manikin (one top view and one side view of each stimulus).

Indirect measures

Both tasks were programmed in E-prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002) and run on a Windows XP computer with a 22 inch CRT monitor (resolution set to 1024 by 768 pixels).

Affective Simon Task-voice key (AST-voice-key). As an index of liking associations with food we used an AST with a voice key, as was originally developed by De Houwer (1998; De Houwer et al., 2001). Each trial started with a 1500 ms presentation of a fixation cross. Next, a picture appeared in the middle of the screen. The picture disappeared when the voice key registered a response from the participant. When no response was registered, the picture automatically disappeared after 3000 ms. Subsequently, the experimenter categorized the response of the participant as 'tasty', 'untasty' or as missing (e.g., because of coughing) on a response box.

The AST-voice-key consisted of a practice block of sixteen trials, followed by two test blocks of 40 trials. Each picture was edited in two different versions (i.e., portrait and landscape) and five different sizes (cf. Huijding & de Jong, 2005). The long side of the pictures was 360, 380, 400, 420 or 440 pixels, and the short side measured 15% shorter. During the AST-voice key, each picture was presented in four different sizes to the participant (randomly selected out of the five different sizes), twice as a portrait and twice as a landscape picture. We used several different picture sizes to prevent participants from using strategies such as fixating on a particular part of the screen to differentiate between portrait and landscape format, thereby enhancing the probability that the irrelevant stimulus feature would also be processed. Two different orders of trials were constructed. Half of the participants were instructed to say the word 'tasty' (in Dutch: 'lekker') when a portrait picture was presented, and 'untasty' (in Dutch: 'vies') when a landscape picture was presented. The other participants had to say 'tasty' when a landscape picture was presented and 'untasty' when a portrait picture was presented. The combination of instruction and order of trials was balanced across participants. Participants were instructed to respond as fast and accurately as possible.

Affective Simon Task manikin version (AST-manikin). As an index of automatic approach tendencies we used a manikin task that was based on the AST originally developed by De Houwer (2001). Each trial started with a 1000 ms presentation of a fixation dot. Next, a picture appeared in the middle of the screen, and a black manikin appeared above or below the picture (see Figure 2.1 for an impression of a typical trial). Participants in our AST-manikin had to move the manikin towards or away from the picture by pressing the arrow buttons (i.e., ↑ or ↓). The picture remained on the screen until the manikin had reached the picture or the edge of the screen. The required response (move towards or away) was defined by the perspective of the picture: the stimuli on the pictures were presented as seen from above or from aside. The content of the stimuli (high-fat food, low-fat food, or neutral pictures) was a task-irrelevant stimulus feature.

Figure 2.1: Example of an AST-manikin trial

The AST-manikin consisted of a practice block of eight trials, followed by two test blocks of 80 trials. Trials differed in stimulus type (i.e., task-irrelevant feature), the side from which the photograph was taken (i.e., task-relevant feature: top view or side view), and position of the manikin (i.e., above or below the picture). Each stimulus was presented four times in each block (top view – manikin above; top view – manikin below; side view – manikin above; side view – manikin below). Trials were presented in random order to the participants. Half of the participants were instructed to move the manikin towards top views and away from side views, and half of the participants were instructed to move the manikin towards side views and away from top views. Instruction was balanced across restrained and unrestrained eaters. Furthermore, participants were instructed to move the manikin as fast and accurately as possible.

The task-relevant feature differed across both types of modified AST's to avoid undesirable influences of training task requirements across tasks. In line with conceptually similar research in the context of specific fears and sexual dysfunctions, for the AST-voice-key we used portrait vs. landscape format of pictures as task-relevant stimulus feature (e.g., Huijding & de Jong, 2005; Brauer, de Jong, Huijding, Laan, & ter Kuile, 2008). For the AST-manikin it was obviously critical to keep a fixed distance between the manikin and the stimulus pictures. For this task we therefore used top view vs. side view of the object displayed on each picture as task-relevant stimulus feature while using a fixed landscape format (380 x 285 pixels).

Self-report measures

Explicit proxies of liking associations and approach tendencies were collected for all food stimuli. Using visual analogue scales, food stimuli of the indirect measures were rated on liking food and craving for food at the moment of testing on a scale from 0 - 100. The explicit proxy of liking associations was measured using the question 'How much do you like this product', which was answered on a scale from 'don't like it at all' to 'like it very much'. The explicit proxy of approach tendencies was measured using the question: 'How much do you crave for this product at this moment?', which was answered on a scale from 'not at all' to 'very much'. Furthermore, the participants were asked to assess the frequency with which they ate the particular food using the question 'How frequently do you eat this food', which was answered on a scale from 'never' to 'very often'.

Different types of overeating were assessed by the RS (Herman & Polivy, 1980) and the Dutch Eating Behavior Questionnaire (DEBQ; Van Strien et al., 1986). The RS is a 10-item scale (0 – 36 points) and provides a measure of restrained eating. High-scorers are people intend to limit their food intake, but often indulge in exactly the foods they want to avoid. The DEBQ consists of three subscales (0 – 5 points): restrained, emotional and external eating. Combination of the latter two subscales provides a measure of disinhibited eating, which refers to a failure of restraining food intake. High scores refer to a tendency for overeating. The Hunger Scale (4 items; Grand, 1968) was also administered to control for the influence of hunger. High scores refer to hunger or deprivation from food.

Procedure

Participants first carried out the AST-voice-key and then the AST-manikin. The order of both tasks was fixed across participants to reduce method variance due to order effects thereby enhancing the sensitivity of both tasks as a measure of individual differences (Asendorpf, Banse, & Mücke, 2002; Steffens & König, 2006; Schnabel, Banse, & Asendorpf, 2006; Glashouwer & de Jong, 2010). We decided to present the AST-voice-key first, to optimize the sensitivity of the design for finding enhanced liking associations, as it can not be ruled out that the impact of the task-irrelevant stimulus feature (e.g., food content) gradually declines because of repeated exposure during the experiment. Following the recommendation of Bosson, Swann, and Pennebaker (2000), the explicit proxies of approach tendencies and liking associations were assessed following completion of the computer tasks. Finally, participants were asked to fill out the questionnaires.[1]

Results

Group characteristics

Restrained and unrestrained eaters did not differ in their self-reported frequency with which they ate high-fat food, $t(53) = 1.10$, $p = .28$, and low-fat food, $t(53) = 0.32$, $p = .75$. They also did not differ with respect to their current motivational state of hunger, $t(53) = 0.84$, $p = .84$, which rules out the influence of hunger as an explanation of potential group differences.

AST-voice-key

Trials of the AST-voice-key with errors (11%) and trials with reaction times below 200 ms were excluded from analyses. Data of two participants (other participants than in the AST-manikin) were excluded from analysis, because of error percentages above 20%, indicating difficulties to comprehend task instructions. Three reaction time scores of participants were detected as outliers (0.9% of all scores) and were adapted to two standard deviations above the mean (Field, 2005).

Data were analyzed using a 3 (stimulus type: high-fat food, low-fat food or neutral pictures) x 2 (response: tasty or untasty) x 2 (group: restrained or

[1] This study is part of a larger project on cognitive-motivational mechanisms in restrained eating. Therefore, an Exogenous Cueing Task was administered (before the rest of the tasks), but these results are presented in a separate paper (Veenstra, de Jong, Koster, & Roefs, 2010)

unrestrained) x 2 (version: “tasty” at landscape pictures or “tasty” at portrait pictures) mixed model analysis of variance with the first two factors being within-subjects factors. If the higher order effects were significant, AST-effects of the AST-voice-key were calculated by subtracting reaction times of “tasty” responses from reaction times of “untasty” responses for each stimulus type. AST-effects of neutral pictures were subtracted from AST-effects of high-fat food and low-fat food. Subtracting these general response tendencies of this reference category from the AST-effects for food allows a proper interpretation of the effects on the target trials. Positive AST-effects are indicative of liking associations, whereas negative scores are indicative of disliking associations.

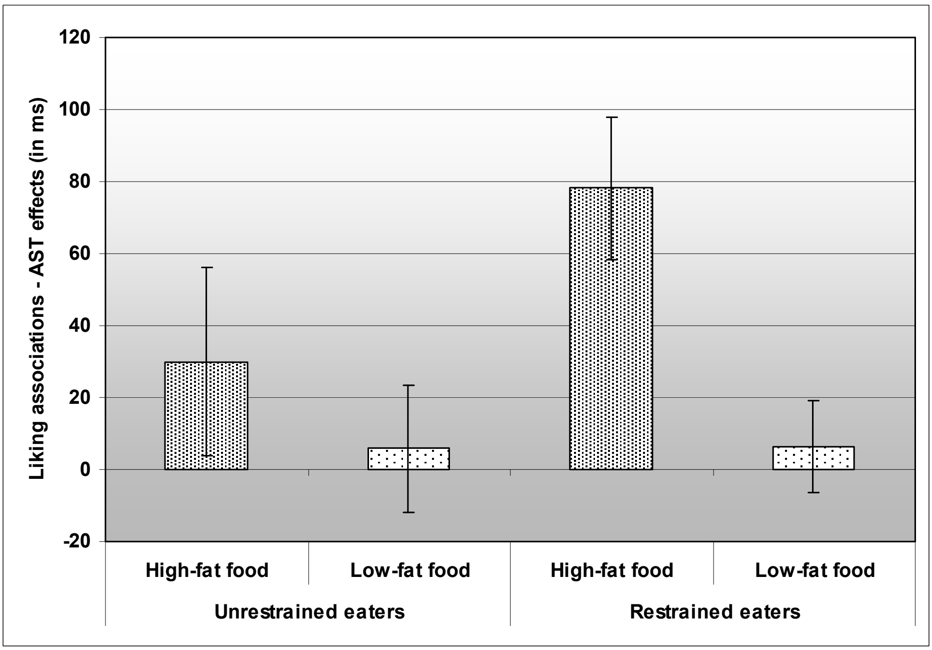

Figure 2.2: AST-effects (in ms) of the AST-voice-key for high-fat food, low-fat food. Positive AST-scores are indicative of liking associations.

Overall effects. A main effect was found for response, $F(1, 49) = 20.99$, $p < .001$, $\eta_p^2 = .30$. Overall, participants were faster when they had to say ‘tasty’ than when they had to say ‘untasty’. In addition, participants responded differentially to the various stimulus types, which appeared from a main effect of stimulus type, $F(2, 98) = 17.26$, $p < .001$, $\eta_p^2 = .26$. Contrasts revealed that participants were faster on low-fat food trials than on both high-fat food, $F(1, 49) = 7.90$, $p < .01$, $\eta_p^2 = .14$, and neutral trials, $F(1, 49) = 44.84$, $p < .001$, $\eta_p^2 = .48$. Furthermore, participants generally responded faster on high-fat food trials compared to neutral trials, $F(1, 49) = 7.65$, $p < .01$, $\eta_p^2 = .14$. No main effect was found for group, $F(1, 49) = 0.15$, $p > .1$, $\eta_p^2 < .01$.

Most importantly, a stimulus type x response interaction was found, $F(1.5, 73)$[2] $= 7.21$, $p < .01$, $\eta_p^2 = .13$, indicating that there was a differential response pattern for high-fat food, low-fat food, and neutral pictures. However, restrained and unrestrained eaters did not differ in this respect, which was apparent from a non-significant stimulus type x response x group interaction, $F(1.5, 73) = 1.28$, $p > .1$, $\eta_p^2 = .03$. Figure 2.2 and Table 2.1 show AST-effects for high-fat food and low-fat food adjusted for neutral pictures (i.e., AST effects for neutral pictures were subtracted from AST effects of high-fat food and low-fat food). Irrespective of group, participants generally showed stronger liking associations with high-fat food than with low-fat food, $t(52) = 2.46$, $p < .05$, $d = .48$. The AST-effects for high-fat food differed from zero, $t(52) = 3.31$, $p < .01$, $d = .45$, whereas the AST-effects for low-fat food did not differ from zero, $t(52) = 0.56$, $p > .1$, $d = .08$.

Table 2.1: AST-effects of approach tendencies and liking associations and their explicit proxies for both high-fat food and low-fat food in restrained and unrestrained eaters.

	Restrained eaters				Unrestrained eaters			
	HF		LF		HF		LF	
Automatic approach tendencies	27.6	(88.9)	35.4	(76.9)	-6.0	(69.8)	-0.8	(74.5)
Explicit craving	61.7	(21.2)	58.4	(16.5)	54.2[a]	(22.7)	60.9[b]	(17.4)
Automatic liking associations	78.1	(102.8)	6.3	(65.9)	30.0	(132.9)	5.8	(90.7)
Explicit liking	83.0	(12.1)	80.0	(10.8)	84.6	(8.1)	83.1	(8.2)

Note. Mean scores, with *SD* in parentheses; AST-effects are corrected for neutral stimuli; HF = high-fat food; LF = low-fat food. Different superscripts (a) refer to differences ($p < .05$) between variables in the same row.

AST-manikin

Trials of the AST-manikin with errors (15%) and trials with reaction times below 200 ms and above 1650 ms, 3 SD above the mean (1,6%), were excluded from analyses. Data of two participants were excluded from analysis, because of error

[2] Due to violation of the assumption of sphericity, Greenhouse-Geisser correction was applied.

percentages above 35%, indicating that these participants had clear difficulties to comprehend task instructions.

Data were analyzed using a 3 (stimulus type: high-fat food, low-fat food, or neutral pictures) x 2 (response: approach or avoidance) x 2 (group: restrained or unrestrained eaters) x 2 (instruction: approach top view or approach side view) mixed models analysis of variance with the first two factors being within-subjects factors. The dependent variable was the reaction time until first press on the key (i.e., initiation time; cf., Solarz, 1960)

If the relevant higher order effects were significant, the effects were analyzed further by calculating AST-effects by subtracting reaction times of approach trials from avoidance trials (cf. Rinck & Becker, 2007). Again, AST-effects of neutral pictures were subtracted from AST-effects of high-fat food and low-fat food pictures. Subtracting these general approach and avoidance tendencies of the reference category from the AST-effects for food allows a proper interpretation of the effects on the target trials. Positive AST-effects are indicative of a tendency to approach rather than to avoid pictures, and negative AST-effects are indicative of a tendency to avoid rather than to approach pictures.

Initiation Time Analysis. A main effect was found for response, $F(1, 49) = 193.8$, $p < .001$, $\eta_p^2 = .80$. Overall, participants were faster when they had to move the manikin towards the stimuli, than when they had to move the manikin away from the stimuli. No main effects were found for group or stimulus type, $F(1, 49) = 0.05$, $p > .1$, $\eta_p^2 < .01$, and $F(2, 98) = 0.28$, $p > .1$, $\eta_p^2 = .01$, respectively.

Most important for the present context, a stimulus type x response x group interaction was found, $F(2, 98) = 3.27$, $p < .05$, $\eta_p^2 = .06$, indicating that restrained and unrestrained eaters showed a differential response pattern to food and neutral pictures. Subsequent analyses were carried out using the AST-effects corrected for neutral pictures, which showed that for restrained eaters the AST-effects (see Figure 2.3 and Table 2.1) of low-fat food differed from zero, $t(27) = 2.43$, $p < .05$, $d = .46$, whereas the AST-effects of high-fat food showed a trend in the same direction, $t(27) = 1.96$, $p = .06$, $d = .31$. In contrast, for unrestrained eaters the AST-effects did not differ from zero, $t(24) = 0.43$, $p > .1$, $d = .09$, and $t(24) = 0.05$, $p > .1$, $d = .01$, for high-fat food and low-fat food respectively. Thus, restrained eaters showed enhanced approach tendencies for food items, whereas such enhanced approach tendencies were absent in unrestrained eaters.

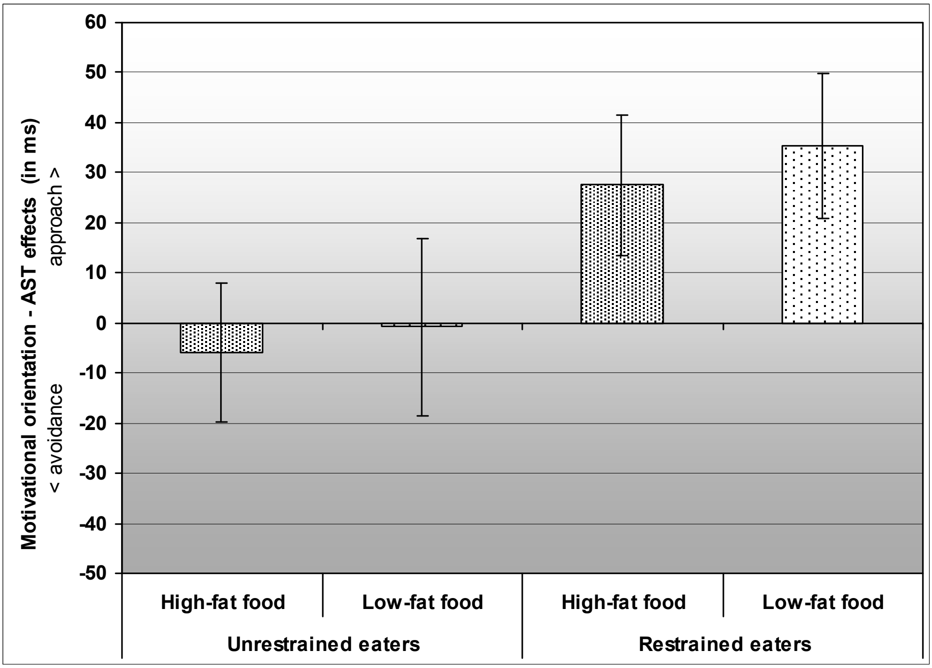

Figure 2.3: AST-effects (in ms) of the AST-manikin for high-fat food and low-fat food in restrained and unrestrained eaters. Positive AST-scores are indicative of approach tendencies.

Explicit proxies of approach tendencies and affective associations

Reported craving. Restrained and unrestrained eaters reported different craving patterns, as evidenced by a borderline significant food type by group interaction, $F(1, 53) = 3.96$, $p = .05$, $\eta_p^2 = .07$ (see also Table 2.1). Unrestrained eaters reported more craving for low-fat food than for high-fat food, $t(26) = 2.20$, $p < .05$, $d = .42$, whereas restrained eaters showed no difference in their self-reports between craving for high-fat food and low-fat food, $t(27) = 0.83$, $p > .1$ (see Table 2.1).

Liking food. No evidence was found for a preference for high- or low-fat food, nor for differences between restrained and unrestrained eaters with respect to their self-reports about liking high-fat and low-fat food, $Fs\,(1, 53) < 1$, $p > .1$.

Relationships between direct and indirect measures. No significant correlations were found between indirect measures and their explicit proxies (*rs* $< .2$, $p > .1$). There was, however, a modest correlation between the automatic liking responses and automatic approach tendencies for high-fat food, $r = .35$, $p < .05$ [by and large this correlation was similar for unrestrained ($r = .35$, $p = .04$) and restrained eaters ($r = .26$, $p = .11$)]. A similar correlation between both AST-effects was absent for low-fat food, $r = .14$, $p > .1$.[3]

Discussion

The present study investigated the role of enhanced approach tendencies (motivational orientation) and liking associations in overeating. The main results can be summarized as follows: independent of restrained status, participants showed stronger automatic liking associations with high-fat food than with low-fat food, whereas such high-fat preference was absent in the more deliberate self-reported liking evaluations. Interestingly, only the group of restrained eaters also showed relatively strong automatic approach tendencies for food. Finally, restrained eaters reported similar craving scores for low-fat and high-fat food, whereas unrestrained eaters reported stronger craving for low-fat than for high-fat food.

Liking associations with food

Previous studies that investigated automatic affective associations with food mostly found negative affective associations with food (Roefs et al., submitted for publication). However, these studies typically used positive-negative as the response dimension. We speculated that a positive-negative dimension might activate evaluations based on health concerns (cf., Roefs et al., 2005b), and therefore used a tasty-untasty dimension to unambiguously activate evaluations based on liking. The present AST-voice-key showed a convincing difference between automatic liking associations with high-fat and low-fat food. Thus, using tasty-untasty as response

[3] We also conducted a 2 (construct: AST-voice-key vs. AST-manikin) x 2 (stimulustype: standardized AST-effects of high-fat vs. low-fat food) x 2 (group: restrained vs. unrestrained eaters) analysis of variance with the first two factors as within-subject factors to see whether there was evidence for a dissociation between automatic liking associations and approach tendencies. However, no evidence was found for such a dissociation, $F(1, 47) = 1.04$, $p > .1$, $\eta_p^2 = .02$.

dimension seemed to be useful in uncovering automatic liking associations. For reaching more final conclusions regarding the critical importance of this specific response dimension, future research should compare both types of response dimensions (positive-negative versus tasty-untasty) within a single experiment.

Most important for the present context, food did not elicit a differential pattern of liking associations between restrained and unrestrained eaters. Thus, the present study provided no evidence to sustain the hypothesis that strong automatic positive affective associations with food play a critical role in the dysregulation of food intake in restrained eaters.

Whereas the AST-voice-key performance indicated that both groups showed stronger automatic liking associations with high-fat food than with low-fat food, a similar positive attitude toward high-fat food was absent at the self-report level. So, there was no indication that explicit liking of high-fat food could influence food intake in restrained eaters. Possibly, health concerns or self-presentational concerns are responsible for the absence of enhanced liking ratings in restrained eaters. However, it should be acknowledged that this discrepancy could be due to the possibility that the indirect measure of liking associations assessed another construct than the self-report measure of liking food. Possibly, the self-report measure more strongly reflected health-concerns than the indirect measure of liking associations.

Approach tendencies towards food

In line with the incentive-sensitization theory (Robinson & Berridge, 1993; 2003), the present study demonstrated relatively strong approach tendencies for food in restrained eaters. These findings are consistent with a previous study using a SRC task with food as a task-relevant feature, and demonstrated stronger approach tendencies in overeaters compared to normal eaters (Brignell et al., 2009). Hence, the present study showed that despite using food as a task-irrelevant feature, restrained eaters still displayed relatively strong approach tendencies for food. With this, our findings attest to the automatic nature of the enhanced food approach tendencies in restrained eaters. These results are consistent with the hypothesis of Robinson and Berridge (1993; 2003) that motivational aspects with respect to food may play an important role in the dysregulation of food intake. Meanwhile, it should be acknowledged that our results seem to be inconsistent with an earlier study on approach tendencies for food in dieters and non-dieters, that showed that dieters displayed a stronger avoidance pattern for food than non-dieters (Fishbach & Shah, 2006). However, this study used a different methodology (i.e., verbal rather than pictorial stimuli, fitness rather than neutral words as a contrast category for food, and stimulus content as task-relevant feature), that might be responsible for these apparently deviating results.

Contrary to our expectations no differential approach pattern was found in restrained eaters for high-fat food and low-fat food. Apparently, restrained eaters are characterized by a motivational orientation towards food in general and not so much by a stronger motivational orientation towards high-fat food. Nevertheless, in weight control specifically the stronger motivational orientation towards high-fat food will produce problems for restrained eaters. Furthermore, the absence of a difference between high-fat and low-fat food could imply that the motivational saliency of food is not elicited by calorie content, but by other aspects of food.

At the self-report level, restrained eaters showed a similar degree of craving for high-fat as for low-fat food, whereas unrestrained eaters showed less craving for high than for low-fat food. This lowered self-reported craving for high-fat compared to low-fat food in unrestrained eaters might serve as protection against overeating. Thus, in overeating, the presence of enhanced automatic approach tendencies together with the absence of reduced deliberate craving for high-fat food might cumulatively contribute to a dysfunctional eating pattern.

Previous research often used automatic approach tendencies as an index of positive affect. Yet, such inference of people's affective evaluations on the basis of their behavioral tendencies may not be necessarily correct. Several authors have argued that the various affective-motivational response systems can be best considered as 'loosely coupled' systems (Zinbarg, 1998), implying that approach tendencies and liking associations may not covary across all situations. The present finding that restrained eaters did show enhanced approach tendencies towards food compared to unrestrained eaters in the apparent absence of enhanced liking associations is consistent with the notion that approach tendencies not necessarily reflect affective evaluations. The very modest correlation between food-relevant automatic approach tendencies and liking associations may be taken as further support for the view that at least under some conditions motivational orientation and liking associations are largely independent.

Limitations and future research

A limitation of the present study concerns its cross-sectional nature. On the basis of the present data it can not be decided whether a relatively strong pattern of approach tendencies for food affects a dysfunctional eating pattern in restrained eaters or whether these approach tendencies are merely symptoms of dysfunctional eating behavior.

Another limitation of the present study is that the fixed order of the tasks hinders a direct comparison of performance on both tasks. All participants started with an Exogenous Cueing Task[1], followed by the AST voice-key, and finally the AST manikin. Because the AST-manikin was always presented following the AST-voice-key, it can not be ruled out that a differential habituation pattern affected the distracting properties of the task irrelevant stimulus feature (picture content) in the AST-manikin. Accordingly, the apparent absence of enhanced approach tendencies in unrestrained eaters may have been due to a relatively fast habituation to food stimuli. Perhaps then, unrestrained eaters would display a similar enhanced approach tendency towards food as restrained eaters if the AST-manikin was administered before (instead of following) the AST-voice key. However, a post-hoc test indicated that there was no evidence of habituation to food stimuli during the AST-manikin (i.e., no differences between food approach tendencies between the first and the second block of the AST-manikin in both groups, $F(2, 98) = .11$, $p > .1$, $\eta_p^2 < .01$). This renders it rather unlikely that task order played a critical role here. However, future research using a balanced order of tasks is necessary to arrive at more final conclusions in this respect.

Restrained eaters as indexed by the RS may not only cover unsuccessful dieters (i.e., overeaters) but may also comprise dieters who are in fact successful in restricting their food intake (Soetens, Braet, Dejonckheere, & Roets, 2006). Although our group of restrained eaters showed higher BMI's than our group of unrestrained eaters, future research could be improved by purely selecting unsuccessful dieters.

Further research is required to clarify the relationship between liking associations with food and approach tendencies for food in different domains of eating disorder pathology. It remains to be seen whether the present results can be generalized to clinical samples of dysfunctional eating behavior or to other types of addictive behavior such as alcohol misuse (cf., Palfai & Ostafin, 2003; Ostafin & Palfai, 2006). In addition, it seems important to study further the potential dissociation of wanting and liking food (cf., Finlayson, King, & Blundell, 2007; Finlayson, King, & Blundell, 2008).

Conclusion

The present study showed that in normal eating, liking associations with food were stronger for high-fat food than for low-fat food, whereas no enhanced motivational orientation towards (high-fat) food was found. Although overeaters demonstrated the same pattern of liking associations with high-fat food as controls, they showed stronger automatic approach tendencies for (high- and low-fat) food. These enhanced approach tendencies for food might contribute to their dysfunctional eating pattern.

Chapter 3

Reduced Automatic Motivational Orientation Towards Food in Restricting Anorexia Nervosa

E. M. Veenstra, P. J. de Jong

Journal of Abnormal Psychology (2011, 120, 708-718)

Abstract

A striking and characteristic feature of the restricting subtype of anorexia nervosa (AN) is that they are extremely successful in regulating their food intake in a destructive manner. A possible explanation for the persistent character of their restricted food intake could be a loss of the motivational saliency of food in restricting AN patients. The present study aimed to investigate motivational orientation for food in the restricting subtype of anorexia nervosa with an indirect performance-based measure and a self-report measure of craving. An indirect approach avoidance task was administered to measure automatic approach tendencies for high-fat and low-fat food in restricting adolescent AN-like patients (n = 89) and a group of healthy adolescents (n = 76). As predicted, restricting AN-like patients showed less automatic motivational orientation towards food than healthy controls. In a similar vein, AN-like patients reported less craving for food than the group of healthy controls. The loss of an automatic motivational orientation towards food together with the deliberate strategy to avoid food might help explain the ability of restricting AN-like patients to regulate their food intake.

Introduction

According to the transdiagnostic view of eating disorders, the core psychopathology of anorexia nervosa (AN) and bulimia nervosa (BN) is described as an overevaluation of weight, shape or control over eating. As a consequence, patients attempt to restrict their eating pattern. However, BN patients eventually fail to restrict their food intake, and use other weight-control behavior (e.g., purging or excessive exercising) to accomplish their goal of losing weight (Fairburn, 2008). A striking feature of patients suffering from anorexia nervosa, and especially the restricting subtype, is the successful persistence of their restricted food intake. Therefore, a critical question is to explain how restricting AN patients manage to successfully regulate their food intake.

One explanation could be that restricting AN patients are characterized by superior self-control, helping them to comply to their goal of dieting even in the presence of a strong adaptive urge to approach food (e.g., Seibt, Häfner, & Deutsch, 2007). Another explanation could be that anorexia nervosa might be maintained because food has lost its incentive value or reward. Accordingly, the positive-incentive theory of anorexia nervosa implies that in restricting AN patients food has lost its habitual incentive value (Pinel, Assanand, & Lehman, 2000). In apparent contrast with this, anorexia nervosa is often associated with obsession for food (i.e., talking about food, cooking food; Garner, 1997; Crisp, 1983), which suggests a positive-incentive value of food. In the positive-incentive theory of anorexia nervosa, however, a distinction is made between a positive incentive value of *eating* food and a positive incentive value of *interacting* with food. The obsession with food in AN patients is concentrated on the interaction with food. The positive-incentive theory of anorexia nervosa proposed that the absence of a positive-incentive value of *eating* food is the most critical in the development of anorexia nervosa. If indeed food has lost its appetitive characteristics in anorexia nervosa, this would logically facilitate the restriction of food intake.

In accordance with the positive-incentive theory of anorexia nervosa, current neurocognitive models suggest that individual differences in affective evaluations of food and motivational orientation towards food influence eating behavior. For example, the incentive-sensitization theory suggests that (de)sensitized motivational processes of food reward might be most critical in explaining dysfunctional eating patterns (Berridge, 1996). These motivational processes are called 'wanting' and refer to craving, appetite or the predisposition to eat. According to this neurocognitive model of food reward, the motivational processes are distinct from subjective awareness and should not only be measured by subjective reports. The registration of food reward processes by subjective reports could easily be biased, as factors like social desirability may influence these direct, reflective measures. Therefore, it seems important to complement these self-reports with more indirect performance measures that are sensitive to more automatic, uncontrollable processes (Fazio & Olson, 2003). Thus, the relevant motivational processes could be reflected in subjective reports of appetite for food, but would especially be identifiable in automatic approach/avoidance behaviors for food.

The relevance of complementing self-reports with performance measures is underlined further by current dual process models that emphasize the importance to differentiate between more deliberate, rule-based (i.e., explicit) self-reports and more automatically activated associations (e.g., Gawronski & Bodenhausen, 2006). Automatic food-associations are assumed to be simple links between food and associated concepts in memory, which can be activated directly in response to relevant stimuli. Thus, when a food-relevant stimulus appears, this is thought to directly activate approach or avoidance-related associations via the spreading of activation from one concept to associated concepts. These automatic associations are thought to influence more spontaneous behavioural responses towards food-relevant stimuli (e.g., Huijding & de Jong, 2006). Subsequently, the input of the associative system is assumed to be used for more deliberate, rule-based mental processing (Strack & Deutsch, 2004) where propositions are weighted according to their 'truth' values (i.e., validation processes; Gawronski & Bodenhausen, 2006). Current dual-system models, propose that automatic and controlled processes independently and jointly influence behavior (e.g., Strack & Deutsch, 2004). The successful restriction of food intake in restricting AN patients, even under conditions that typically impair self-control (e.g., time pressure, cognitive depletion, stress), may thus be explained by assuming that automatic responses towards food are less favorable among restricting AN patients than among normal eaters or BN patients. Otherwise one would have expected that self-control would break down under some conditions, as it is the case with BN, restrained eaters, but also AN with binge-purge cycles.

Empirical evidence of this hypothesis in restricting anorexia nervosa is still rare. One study using an affective priming approach found evidence in line with this reasoning, and showed an automatic preference of palatable food in healthy controls, whereas this preference was absent in anorexia nervosa patients (Roefs et al., 2005). This study contributes to the hypothesis that food has lost its positive-incentive value in anorexia nervosa. However, because (automatic) liking of food may diverge from people's behavioral tendencies (e.g., Veenstra & de Jong, 2010), and approach-avoidance behaviors may be automatically activated upon confrontation with particular stimuli independently of evaluation intentions (Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010), it remains to be seen whether restricting AN patients also show relatively weak approach tendencies toward food.

A previous study that actually tested automatic approach tendencies for food in a clinical sample of women with eating disorders that partly consisted of AN patients revealed no evidence for a relatively weak approach tendency in eating disordered individuals compared to a nonselected group of undergraduate students (Seibt et al., 2007; exp. 3). In addition, for both groups approach tendencies were strongest right before than immediately after lunch. Thus also in the eating disordered sample food deprivation was associated with enhanced rather than reduced approach tendencies toward food stimuli. However, this study (Seibt et al., 2007) has several limitations that preclude drawing final conclusions regarding the role of automatic approach-avoidance tendencies in restricting AN patients. Most important for the present context, the clinical sample consisted of both AN and BN patients. According to our hypothesis, specifically in restricting AN patients a reduced tendency to approach food should be apparent. In addition, there were no non-food control stimuli in this design and it remains therefore to be tested whether the pattern of findings was specific for food stimuli and/or whether there were baseline differences between both groups in their responding to the approach-avoidance task. All in all, it requires further research to arrive at more final conclusions regarding the role of differential approach-avoidance tendencies in restricting AN.

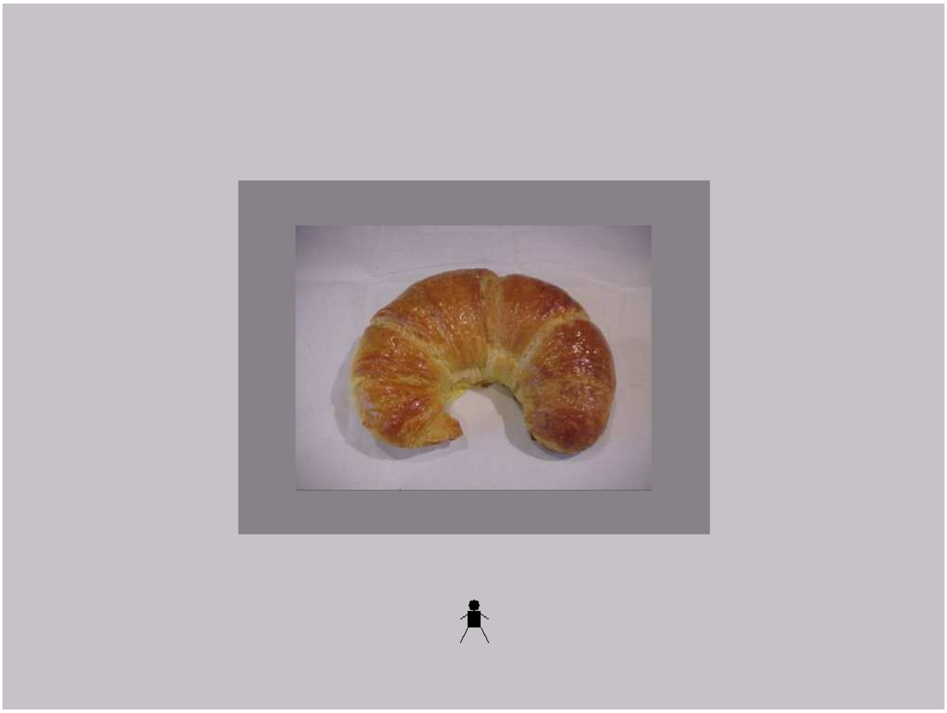

Figure 3.1: Example of an AST-manikin trial

Therefore, the goal of the present study was to investigate further the motivational orientation towards food in a large clinical sample of restricting AN-like patients. To examine participants' automatic approach tendencies for food, we used a pictorial Affective Simon Task (AST; De Houwer, Crombez, Baeyens, & Hermans, 2001). The AST is a highly flexible irrelevant feature task which is administered on the computer, and is based on the originally spatial Simon paradigm (Simon & Rudell, 1967). In the AST, participants are presented with a picture and a manikin on a screen (see Figure 3.1 for a typical trial). Participants are instructed to ignore the content (i.e., food and neutral objects) of the pictures and respond as fast as possible by moving the manikin towards or away from the picture using the arrow keys on the keyboard. Participants have to approach or avoid pictures depending on a feature of the stimulus that is irrelevant to the research question. For example, participants are instructed to move the manikin away from the picture when presented in top view, and move the manikin towards the picture when presented in side view (e.g., Veenstra & de Jong, 2010). The pictorial AST has three elements: the so-called task-relevant feature that determines the required response (e.g., top view vs. side view), the task-irrelevant feature that has to be ignored (e.g., picture content such as food items), and the response (e.g., moving a manikin away vs. towards the picture). The movement of the manikin towards or away from the picture corresponds to an approach or an avoidance motivation, respectively (Mogg, Bradley, Field, & De Houwer, 2003).

Although task performance would improve if the content of the pictures could be ignored (and participants were explicitly instructed to do so), typically participants make more errors and/or respond more slowly when the required response is incongruent with the response tendency that is elicited by the task-irrelevant picture. In the present AST, participants were presented with food items as the irrelevant stimulus feature, and were instructed to respond to a non-food feature of the stimulus (i.e., perspective: top view vs. side view) by moving a manikin away or towards the pictorial stimuli. To the extent that food automatically elicits an approach tendency, it will be easier to move the manikin towards the tasty food picture than to move the manikin away from the picture. Thus when the relevant stimulus feature requires that the food stimulus should be approached, the required response can be considered as a congruent response (i.e., congruent with the spontaneously elicited response). If on the other hand the relevant stimulus feature requires an avoidance response this can be considered as an incongruent response (i.e., incongruent with the spontaneously elicited response). These interference effects of the task-irrelevant content of the stimulus are assumed to reflect the automatic approach/avoidance tendencies (cf., Krieglmeyer et al, 2010). These interference effects are automatic in the sense of being involuntary and present regardless of the participants' intentions (cf., Dienes & Perner, 1996).

Previous research in other domains of psychopathology has shown that measures of motivational orientation can be linked to measures of actual behavior. For example, studies in the context of spider phobia have shown that automatic avoidance tendencies as indexed by an approach avoidance task have predictive validity for actual approach/avoidance behavior during a Behavioral Approach Test (Rinck & Becker, 2007). Supporting the view that this type of automatic approach/avoidance tendencies might have a causal influence on actual behavior, a training study of motivational orientation towards alcohol in problem drinkers revealed that a trained decrease in automatic approach tendencies towards alcohol was associated with lower alcohol consumption (Wiers, Rinck, Kordts, Houben, & Strack, 2010).

The major aim of the present study was to test if food elicits relatively weak approach tendencies in adolescents with broadly defined anorexia nervosa of the restricting type. Approach tendencies for food are reflected by relatively few errors and/or fast responses when the required response on trials displaying food is to approach the stimulus, and relatively many errors and/or slow responses when the required response on food trials is to move away from the stimulus. As high-fat food is most relevant when it comes to the regulation of caloric intake, we examined whether the reduced approach tendencies would be restricted to high-fat food and included also trials portraying low-fat food items.

Method

Participants

All patients who were admitted to the Department of Eating Disorders of Accare in Smilde were diagnosed by the child version of the Eating Disorder Examination (EDE; Bryant-Waugh, Cooper, Taylor, & Lask, 1996; Dutch version: Decaluwé & Braet, 1999) within two weeks after admission. A group of restrictive eaters was selected by including a group of broadly defined AN patients (n = 89). Accordingly, we included female patients who met criteria of the restrictive type of AN (n = 41). In addition, we included female patients who met criteria of AN subgroups of Eating Disorder Not Otherwise Specified (EDNOS; n = 48). For these AN-like subgroups, we selected patients who met criteria of AN with menses (n = 13), high-weight AN (n = 16), non-fat phobic AN (n = 5), and partial AN (n = 15; cf., Thomas, Vartanian, & Brownell, 2009). Control group participants (n = 76) were matched on age and education and were selected from the Gomarus College, a large secondary school in Groningen. See Table 3.1 for a description of both groups of participants. Eating disordered patients and healthy controls did not differ with respect to their educational level, $\chi^2(1) = .25$, $p > .1$, or their age, $t(163) = .43$, $p > .1$, $d = .07$.

Stimulus selection

Stimulus selection for the Affective Simon Task was based on a study on the evaluation of high-fat and low-fat foods (Roefs et al., 2005a). Pictorial stimuli were used, as pictures may provide a more ecologically valid representation of food than words, and pictorial stimuli are generally assumed to be more strongly related to affective information than words (De Houwer & Hermans, 1994). The stimuli consisted of eight high-fat food pictures (pizza, croissant, chocolate, crisps, chips, ice-cream, brown spiced biscuit, and toast with ham and cheese), eight low-fat food pictures (strawberries, melon, grapes, popcorn, carrots, cherries, pineapple, and chicken). Five neutral stimuli were based on number 7006 (i.e., bowls) and 7009 (i.e., mugs) of the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1996). Of every stimulus, two different pictures (380 x 285 pixels) were constructed: one top view and one side view of each stimulus.

Affective Simon Task manikin version (AST-manikin)

As an index of automatic approach tendencies we used a manikin task that was based on the AST originally developed by De Houwer (De Houwer et al., 2001). The task was programmed in E-prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002) and run on a Windows XP computer with a 22 inch CRT monitor (resolution set to 1024 by 768 pixels). Each trial started with a 1000 ms presentation of a fixation dot. Next, a picture appeared in the middle of the screen, and a black manikin appeared above or below the picture (see Appendix A for an impression of a typical trial). Participants in our AST-manikin had to move the manikin towards or away from the picture by pressing the arrow buttons (i.e., ↑ or ↓) until the manikin reached the picture or the edge of the screen. When moving the manikin, the legs of the manikin changed size, which created an actual movement perception. An approach movement was made, when the manikin ‘walked’ towards the picture on the screen, and an avoidance movement was made when the manikin ‘walked’ away from the picture on the screen. The required response (move towards or away) was defined by the perspective of the picture: the stimuli on the pictures were presented as seen from above or from aside. The content of the stimuli (high-fat food, low-fat food, or neutral pictures) was a task-irrelevant stimulus feature, and should thus be ignored. When a correct response was made, the next trial started automatically. In case of an incorrect response, the next trial appeared when the erroneous response was corrected.

The AST-manikin consisted of a practice block of eight trials, followed by two test blocks of 84 trials each. Trials differed in stimulus type (i.e., task-irrelevant feature), the side from which the photograph was taken (i.e., task-relevant feature: top view or side view), and position of the manikin (i.e., above or below the picture). Each stimulus was presented four times in each block (top view – manikin above; top view – manikin below; side view – manikin above; side view – manikin below). Trials were presented in random order to the participants. Half of the participants were instructed to move the manikin towards top views and away from side views, and half of the participants were instructed to move the manikin towards side views and away from top views. During the whole task this instruction was the same to avoid interference effects. Instruction was balanced across eating disordered patients and healthy controls. Furthermore, immediately preceding the start of the experiment participants were instructed to move the manikin as fast as possible.

Self-report measures

Explicit proxies of approach tendencies were collected for all food stimuli. Using visual analogue scales, food stimuli of the AST-manikin were rated on craving for food at the moment of testing on a scale from 0 - 100. The explicit proxy of approach tendencies was measured using the question: 'How much do you crave this product at this moment?', which was answered on a scale (0 - 100) from 'not at all' (0) to 'very much' (100). Furthermore, the participants were asked to assess the frequency with which they ate the particular food using the question 'How frequently do you eat this food', which was answered on a scale (0 - 100) from 'never' (0) to 'very often' (100).

Furthermore, participants filled out two questionnaires. The child version of the Eating Disorder Examination - Questionnaire (EDE-Q; Fairburn & Beglin, 1994; ChEDE-Q; Decaluwé, 1999) was administered, to allow for a comparison of eating disorder pathology between AN-like patients and healthy controls. The EDE-Q is the questionnaire version of the Eating Disorder Examination and consists of four subscales (0 – 6 points): restraint, eating concern, weight concern, and shape concern. The total EDE-Q score provides a global measure of the severity of eating disorder pathology. Furthermore, the Hunger Scale (Grand, 1968) was administered to control for the influence of hunger. The Hunger Scale consists of four items: time since last eating (hrs), subjective hunger (1 – 6 points), the subject's estimate of the amount of favourite food she would be able to eat (1 - 7), and the time till next meal (hrs). High scores refer to hunger or deprivation from food.

Procedure

Participants first carried out the AST-manikin task. Following the recommendation of Bosson, Swann, and Pennebaker (2000), the self-report measures were assessed following completion of the computer tasks. Finally, weight and height data of all participants were collected.[4]

Results

Group characteristics

In line with the selection criteria, restricting AN-like patients had a lower Body Mass Index (BMI) than healthy controls, $F(1, 160) = 199.8$, $p < .001$, $d = 2.21$, and higher percentages of underweight, $F(1, 160) = 160.8$, $p < .001$, $d = 1.98$ (see Table 3.1 for a description of the samples). Furthermore, EDE-Q scores confirmed that eating disorder pathology was more prominent in the group of restricting AN-like patients, $F(1, 160) = 167.8$, $p < .001$, $d = 2.11$.

[4] This study is part of a larger project on cognitive-motivational mechanisms in anorexia nervosa. Therefore, also an Exogenous Cueing Task was administered, but these results will be presented in a separate paper. Furthermore, an AST-voice-key was administered to measure automatic liking associations in restricting AN-like patients. Whereas this AST-voice-key revealed convincing evidence concerning liking associations in an earlier study with restrained and unrestrained eaters (Veenstra & de Jong, 2010), in the present study the task was ineffective, and failed to find liking associations. No differences were found between responses to food and neutral trials. Possibly, a difference in age can account for the ineffectiveness of the task in this study, as the present study was administered in a group of adolescent secondary school pupils instead of undergraduate students. During the study we observed that the task-relevant stimulus feature (i.e., distinction between portrait and landscape, which was a difference of 15% between both sides) was relatively difficult for this age group. So, the portrait-landscape distinction might have resulted in more conscious responses, so that the variability in reaction times was ruled out, and no liking associations could be found.

Tabel 3.1.: Group characteristics

	Restricting AN-like patients (n = 89)		Healthy controls (n = 76)		Between-groups test	
	M	*SD*	*M*	*SD*	*F*	*p*
Education[5]						
Low-level	(n = 29)		(n = 25)			
Age	14.52	2.03	14.32	1.46	0.16	.690
High-level	(n = 50)		(n = 51)			
Age	15.02	1.45	15.12	1.75	0.09	.760
Underweight (%)	19.34	9.25	-1.55	11.73	160.78	< .001
Body Mass Index	15.71	1.87	20.42	2.37	199.75	< .001
EDE-Q – Restraint	3.15	1.54	0.96	1.02	105.86	< .001
EDE-Q – Eating Concern	2.69	1.29	0.55	0.58	172.39	< .001
EDE-Q – Weight Concern	3.52	1.57	1.08	1.04	127.70	< .001
EDE-Q – Shape Concern	3.87	1.67	1.11	1.12	142.52	< .001
EDE-Q – Total score	3.31	1.36	0.93	0.84	167.78	< .001
HS – Time since last meal (hrs)	3.12	2.92	2.31	2.25	3.86	.051
HS – Subjective hunger (1–6)	2.25	1.60	4.17	1.40	65.13	< .001
HS – Subject's estimate of the amount of favorite food she would be able to eat (1–7)	2.06	1.33	3.86	0.95	95.27	< .001
HS – Time till next meal (hrs)	1.56	1.95	1.48	1.27	0.08	.780
HS – Total score	8.98	5.01	11.82	3.00	18.34	< .001
Frequency of eating high-fat food (0–100)	20.25	14.52	49.72	14.65	167.60	< .001
Frequency of eating low-fat food (0-100)	37.74	17.48	43.46	14.21	5.21	.024

Note. EDE-Q = Eating Disorder Examination – Questionnaire (Decaluwé, 1999); HS = Hunger Scales (Grand, 1968).

Restricting AN-like patients reported a lower motivational state of hunger than the control group, $F(1, 159) = 18.34$, $p < .001$, $d = .69$. However, the total hunger score may be biased as consistent with their cognitions AN-like patients generally report a relatively low state of hunger or to experience no hunger at all. Therefore, the most objective measure of deprivation is probably the time since participants' last eating. For the Hunger Scale item 'time since last eating' a trend was found, $F(1, 159) = 3.86$, $p = .051$, $d = .31$. Restricting AN-like patients tended to report a longer time since last eating. Furthermore, compared to healthy controls restricting AN-like patients reported lower frequencies with which they ate high-fat food, $F(1, 163) = 167.60$, $p < .001$, $d = 2.02$, as well as low-fat food, $F(1, 163) = 5.21$, $p < .05.$, $d = .36$.

[5] Of 10 AN-like patients information about education was not disclosed.

AST-manikin

Trials of which the first responses were in the wrong direction were identified as errors (i.e., a trial in which a participant's first response was to approach a high-fat food picture, and the instruction was to avoid the picture). The major analyses concentrated on errors as it is not uncommon to find pictorial AST-effects in errors (probably because task instruction focuses more on maximizing speed than accuracy; see e.g., Huijding & de Jong, 2006b; Stahl & Degner, 2007; Vervoort et al., 2010). For a more comprehensive description of participants' responding, we also examined the initiation time, which is the reaction time until first press of the key for the correct trials (cf. Solarz, 1960).

Error rates and initiation times were analyzed using a 3 (stimulus type: high-fat food, low-fat food, or neutral pictures) x 2 (response: approach or avoidance) x 2 (group: Restricting AN-like patients or healthy controls) mixed models analysis of variance with the first two factors being within-subjects factors. We included 'time since last eating' as a covariate. This enables to test group differences independently of food deprivation which might be important because previous research showed that food deprivation can predict approach tendencies for food (Seibt et al., 2007).

If the relevant higher order effects were significant, the effects were analyzed further by calculating AST-effects by subtracting error percentages / reaction times of approach trials from avoidance trials (cf. Rinck & Becker, 2007). Positive AST-effects are indicative of a tendency to approach rather than to avoid pictures, and negative AST-effects reflect a tendency to avoid rather than to approach pictures.

All effects are reported as significant at $p < .05$. Effect-sizes are also reported using partial eta-squared (η_p^2; small: 0.01, medium: 0.06, and large effect: 0.14 (Cohen, 1977)) or Cohen's d (small: 0.20, medium: 0.50, and large effect: 0.80 (Cohen, 1992)).

Error Analysis

Most important for the present context, the expected interaction of stimulus type x response x group was significant, $F(1.67, 264)$[6] = 4.02, $p = .026$, $\eta_p^2 = .03$. In addition, there were some other significant effects that were not directly relevant for our hypothesis. First, there was a main effect of response, $F(1, 158) = 112.78$, $p < .001$, $\eta_p^2 = .42$. Overall, participants performed better (i.e., less errors) on approach trials than avoidance trials. Second, there was a trend for stimulus type, $F(1.83, 289)$[6] = 2.51, $p = .088$, $\eta_p^2 = .16$. Participants performed better at low-fat food trials compared to high-fat food and neutral trials, $F(1, 158) = 4.01$, $p = .047$, $\eta_p^2 = .03$, and $F(1, 158) = 4.30$, $p = .040$, $\eta_p^2 = .03$, respectively. Participants performed equally on high-fat food trials compared to neutral trials, $F(1, 158) = 0.14$, $p > .1$, $\eta_p^2 < .001$. Pairwise comparisons revealed that control group participants made more errors than restricting AN-like patients when they had to avoid high-fat food, $F(1, 164) = 3.87$, $p = .026$, $d = .30$. For low-fat food a trend was found in the same direction, $F(1, 164) = 2.33$, $p = .065$, $d = .24$. No group differences were found when participants had to avoid neutral pictures, $F(1, 164) = 0.19$, $p > .1$, $d = .06$. Furthermore, no group differences were found on performance on approach trials of high-fat food, low-fat food and neutral pictures, all p's > .1.

In line with previous research using the AST, we subsequently calculated AST-error effects for high-fat food, low-fat food, and neutral pictures (see Figure 3.1). Control group participants showed stronger AST-error effects for high-fat food and low-fat food than the group of restricting AN-like patients, $F(1, 164) = 7.86$, $p = .003$, $d = .45$, and $F(1, 164) = 3.09$, $p = .041$, $d = .29$, respectively. No such differences were found for neutral trials $F(1, 164) = .03$, $p > .1$, $d = .04$. Within the group of healthy controls, AST-error effects of high-fat food and low-fat food were stronger than the AST-error effects of neutral pictures, $t(75) = 3.85$, $p < .001$, $d = .44$, and $t(75) = 3.38$, $p = .001$, $d = .38$, respectively. In contrast to the healthy controls, in the group of restricting AN-like patients no differences were found between approach/avoidance tendencies for food and neutral pictures, all p's > .1.

[6] Due to violation of the assumption of sphericity, Greenhouse-Geisser correction was applied.

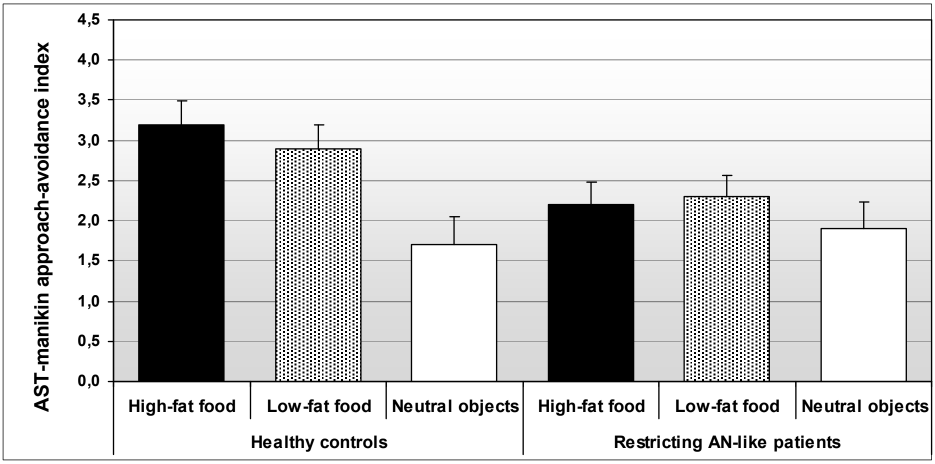

Figure 3.1: AST-manikin approach-avoidance index (i.e., differences in error rates between approach and avoidance trials) as a function of group and stimulus type. Higher values indicate stronger approach tendencies. Error bars represent standard errors of the mean.

Table 3.2.: AST-manikin: number of errors and initiation times as a function of group and stimulus type

	Healthy controls						Restricting AN-like patients					
	HF		LF		NEU		HF		LF		NEU	
Number of errors												
Approach	2.2	(1.6)	2.1	(1.5)	3.1	(1.8)	2.5	(1.5)	2.1	(1.5)	2.8	(1.8)
Avoidance	5.4	(2.6)	4.4	(2.6)	4.8	(2.8)	4.7	(2.7)	4.4	(2.6)	4.7	(3.1)
AST Effects	3.2	(2.5)	2.9	(2.5)	1.7	(3.1)	2.2	(2.7)	2.3	(2.5)	1.9	(3.1)
Initiation time												
Approach	817	(145)	798	(139)	813	(158)	816	(199)	781	(157)	821	(165)
Avoidance	934	(160)	922	(167)	903	(156)	923	(134)	895	(135)	909	(176)
AST Effects	116	(107)	126	(109)	94	(144)	106	(127)	116	(98)	89	(117)

Note. Mean characteristics, with *SD* in parentheses; HF = High-fat food, LF = Low-fat food, NEU = Neutral objects.

Initiation Time Analysis.

In the initiation time analysis, trials of the AST-manikin with errors (22%) and trials with reaction times below 200 ms and 3 SD above the mean were excluded from analyses (cf., Veenstra & de Jong, 2010). Data of participants with error percentages above 41% (M + 2 SD; n = 6) were excluded from analysis. The critical interaction of group x stimulus type x response was not significant, $F(1.83, 279)$[6] = 0.05, $p > .1$, $\eta_p^2 < .01$ (see Table 3.2 for the AST-effects of the initiation time analysis). However, there was a nonsignificant tendency for stimulus type x response suggesting that approach/avoidance tendencies differed across different stimulus types, $F(1.83, 279) = 2.58$, $p = .082$, $\eta_p^2 = .02$. Overall, participants responded faster when they had to approach low-fat food than when they had to approach high-fat food, $t(158) = 3.87$, $p < .001$, $d = .17$, or neutral pictures, $t(158) = 3.92$, $p < .001$, $d = .19$. Participants responded slower when they had to avoid high-fat food than when they had to avoid low-fat food, $t(158) = 2.62$, $p = .010$, $d = .13$, or neutral pictures, $t(158) = 2.17$, $p = .031$, $d = .12$. Subsequently, we also calculated the AST-effects of high-fat food, low-fat food and neutral pictures. Participants showed higher AST-effects for low-fat food than for neutral objects, $t(156) = 2.30$, $p = .023$, $d = .25$. Participants showed the same pattern for high-fat food, but this was not significant, $t(156) = 1.48$, $p = .142$, $d = 16$.

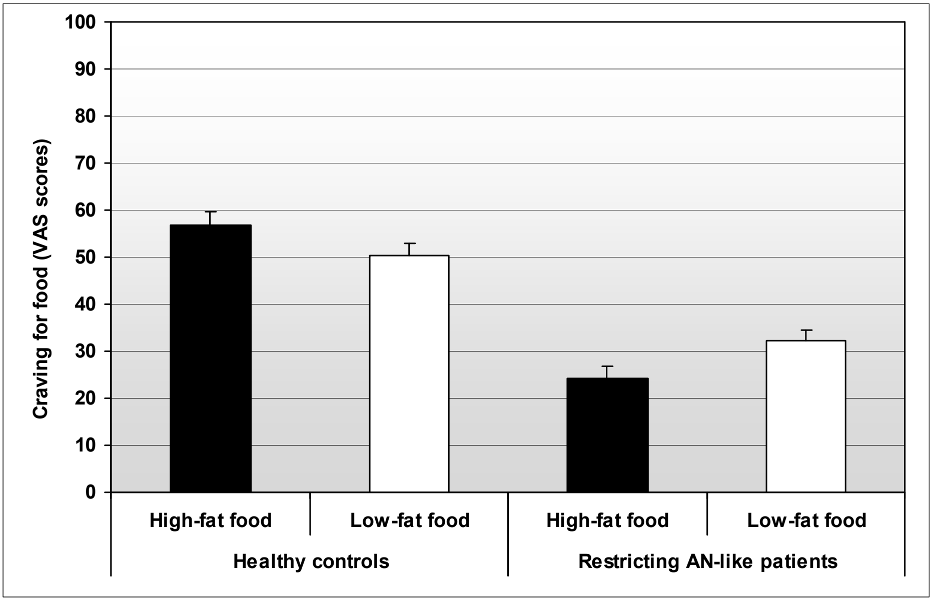

Figure 3.2: Explicit proxies of approach tendencies: craving for food

Self-report measure: craving food

The analysis of craving scores revealed a main effect of group, $F(1, 163) = 61.02$, $p < .001$, $\eta_p^2 = .27$. Overall, restricting AN-like patients reported less craving for food compared to the healthy controls (see Figure 2). Interestingly, the analysis revealed a significant interaction effect of food type x group, $F(1, 163) = 15.83$, $p < .001$, $\eta_p^2 = .09$. Restricting AN-like patients reported stronger craving for low-fat food than for high-fat food, $t(88) = 3.35$, $p < .001$, $d = .36$, whereas healthy controls reported stronger craving for high-fat food than for low-fat food, $t(75) = 2.34$, $p = .022$, $d =$

.27. No significant correlations were found between automatic approach tendencies of high-fat and low-fat food and their explicit proxies of craving food (*rs* < .2, *p* > .1).

Table 3.3: Correlations between indices of motivational orientation towards food and indices of disordered eating behavior.

	AST-error effects	
	High-Fat Food	Low-Fat Food
EDE-Q – Total score	-0.19*	-0.08
Underweight (%)	-0.28**	-0.21**
Frequency of eating high-fat food	0.16*	0.11
Frequency of eating low-fat food	0.07	0.09

Note. EDE-Q = Eating Disorder Examination – Questionnaire (Decaluwé, 1999)
*$p < .05$
**$p < .01$

Post-hoc correlational analysis

To explore further the relationship between eating behavior and approach tendencies for food, we computed Pearson's *p-m* correlations between indices of motivational orientation towards food (i.e., AST-error effects of high-fat and low-fat food) on the one hand, and indices of disordered eating behavior (self-reported frequency of eating high-fat and low-fat food, percentage of underweight, EDE-Q) on the other hand. See Table 3.3 for an overview of the correlations.
Correlational analysis revealed a negative correlation between the total score of the EDE-Q and the AST-effect of high-fat food, whereas no correlation was found with the AST-effect of low-fat food. Thus people with relatively high scores on the EDE-Q showed less approach tendencies towards high-fat food. (The same pattern was evident for all subscales of the EDE-Q). Furthermore a negative correlation was found between percentages of underweight and the AST-effects of both high-fat food and low-fat food. The more participants had underweight, the less approach tendencies they demonstrated towards high-fat food and low-fat food.

A positive correlation was found between the frequency of eating high-fat food and the AST-effect of high-fat food, whereas no correlation was found with the AST-effect of low-fat food. Thus, participants who demonstrated stronger automatic approach tendencies towards high-fat food, also reported a relatively high frequency of eating high-fat food. A similar association was absent for low-fat food.

Discussion

The present study investigated the role of approach tendencies for food in restricting AN-like patients. The major results can be summarized as follows: (i) error analysis of the AST showed that in contrast to healthy controls, restricting AN-like patients showed no motivational orientation towards food; (ii) in a similar vein, restricting AN-like patients reported less craving for food than healthy controls; (iii) restricting AN-like patients reported relatively strong craving for low-fat food, whereas healthy controls reported relatively strong craving for high-fat food. Furthermore, (iv) initiation time analysis revealed a pattern of stronger motivational orientation towards low-fat food compared to neutral objects independently of group. Finally, (v) post-hoc correlational analysis demonstrated that motivational orientation for high-fat food was less pronounced in participants with relatively low weight and relatively high scores on eating disorder pathology. Furthermore, motivational orientation for high-fat food was more pronounced in participants who reported relatively high frequencies with which they ate high-fat food.

Motivational orientation

In line with our hypothesis, healthy controls made relatively many errors when they had to avoid food trials compared to restricting AN-like patients. Thus, the error index indicated that, in contrast to healthy controls, restricting AN-like patients showed less automatic motivational orientation towards food. This pattern of results is in line with the view that there is a loss of the usual motivational saliency of food in (restricting) AN-like patients (Pinel et al., 2000). It also accords well with the incentive-sensitization theory (Robinson & Berridge, 1993; 2003) that attributes a critical role to motivational aspects in the regulation of food intake. Whereas the motivational orientation towards food seemed to be sensitized in overeaters (Veenstra & de Jong, 2010), motivational orientation towards food seemed to be desensitized in restricting AN-like patients. The loss of motivational saliency of food could enable restricting AN-like patients to adhere to a deliberately restricted eating pattern. The correlations between automatic motivational orientation and indices of eating pathology (weight, EDE-Q) and eating pattern are also consistent with this view. Clearly, because of the cross-sectional nature of the present data one can only speculate about the direction of these relationships. An important and interesting next step would therefore be to test these relationships in a longitudinal design.

Results of the present study differ from a food deprivation study in eating disordered patients and controls (Seibt et al., 2007). Using an AST-joystick to index automatic approach tendencies toward food pictures, this earlier study found no differences between eating disordered patients and controls. However, the eating disorder sample comprised of two small samples of both successful and unsuccessful dieters (i.e., BN patients (n = 7) and AN patients (n = 13)), which renders these results difficult to interpret in the context of the (un)successful regulation of food intake. In addition, it can not be ruled out that methodological differences between the studies might have contributed to the apparent inconsistency in results. For example, in our AST-manikin there was no relationship with the task relevant feature and the type of response that was required (move manikin upwards or downwards), whereas in the AST-joystick the task-relevant feature also defined whether participants should pull or push. This feature might have rendered the AST-joystick more vulnerable to task-recoding and strategic control than the present AST-manikin, and may thus give rise to different results. In addition, the present sample comprised of early adolescents instead of adult participants. Perhaps age-related differences in executive control and/or sensitivity to task-irrelevant stimulus features might influence participants' task performance. Furthermore, the study of Seibt et al. (2007) showed that food deprivation was associated with stronger approach tendencies in both eating disordered patients and healthy controls. Accordingly, one could speculate that the difference between the clinical sample of restricting AN-like patients and the control group in the present study might perhaps reflect differences in food deprivation. However, entering 'time since last eating' as a covariate in the analysis did not affect the outcome of the present study, which renders this explanation not very likely.

A similar pattern was absent in the initiation times (response latencies) of the correct responses. The pattern of initiation times suggests that restricting AN-like patients were able to suppress the saliency of food when selecting the proper response option (approach or avoid) during the task, whereas the saliency of food did affect their reaction times when they had to approach/avoid low-fat food.

Consistent with their dieting goals, only low-fat food elicited relatively strong approach tendencies in restricting AN-like patients. However, control participants showed the same response pattern, and it seems therefore to be a more general tendency that young adolescents show a relatively strong motivational orientation towards (low-fat) food. This finding is in accordance with the hypothesis of Seibt, Häfner and Deutsch (2007), as they stated that the tendency to approach is a basic adaptive mechanism, that could not (easily) be influenced by eating pathology. However, these RT findings should be interpreted with care as differential AST-error effects could have affected the pattern of RT data.

The finding that expected AST-effects were only evident in the error rates is not uncommon for the pictorial AST (Huijding & de Jong, 2006; Stahl & Degner, 2007; Vervoort et al., 2010), and can probably be explained by the task instructions, which focus more on maximizing speed than accuracy. Moreover, similar to previous work in the context of (young) adolescents, participants in the present study made relatively many errors. Because the elevated error rate reduced the number of observations per relevant type of trial, this may have further reduced the reliability of the RT data. Moreover, because errors were not equally distributed across type of trials, an inadvertent trade-off effect may have occurred, making it even more difficult to interpret the pattern of RTs. Thus the RT pattern, suggesting that young adolescents generally display an approach tendency towards food that is especially pronounced for low-fat food should be interpreted with care.

Explicit proxy of approach tendencies

Explicit strategies of restricting AN-like patients might also contribute to the development and maintenance of their restricted eating pattern. Analysis of scores of craving for food revealed differential patterns in restricting AN-like patients and healthy controls. In agreement with earlier research on food cravings in restricting AN-like patients, restricting AN-like patients reported relatively low levels of food craving (Moreno, Warren, Rodríguez, Fernández, & Cepeda-Benito, 2009). Interestingly, consistent with their dieting rules restricting AN-like patients reported stronger craving for low-fat than for high-fat food. On the contrary, healthy individuals reported stronger craving for high-fat than low-fat food. Nevertheless, these results should be interpreted with care as expectations of restricting AN-like patients about how they think that they are supposed to respond might have influenced these self-reports of craving in the same direction. Furthermore, the relationship between automatic motivational orientation and self-reports of craving for food is still unclear, as no correlation was found between these processes. Possibly, these processes are independent processes that do not influence each other.

Limitations and future research

First of all it should be acknowledged that the differential effects of automatic motivational orientation were small. The relatively high error rate in this study suggests that one explanation for the small effects might be that the present AST-manikin task was rather difficult for the present group of participants. The apparent high task difficulty might have introduced substantial error variance thereby reducing the sensitivity of the present task as an indirect measure of automatic approach-avoidance behavior. Previous research using this type of tasks relied predominantly on adult (student) samples. In these studies, the error rates are typically much smaller (e.g., Veenstra & de Jong, 2010; Krieglmeyer et al., 2010), suggesting that the many errors in the present study were probably not merely due to the task features per se, but were also due to age-related aspects such as the participants' stage of cognitive development (cf. Kindt & Van Den Hout, 2001). Perhaps using a more easy to discriminate relevant task feature might enhance the sensitivity of the AST-manikin for younger age groups. As a related issue, it should be acknowledged that the AST effects expressed in RTs were not consistent with the AST effects expressed in participants´ pattern of errors. As already discussed above, at least part of this apparent discrepancy might be due to speed-accuracy trade off effects. In future research it might be helpful to more strongly emphasize the importance of accurate responding as this might help to reduce errors and may contribute to a more straightforward and more strong effect on participants' response latencies.

The results of the error data seem to indicate that the difference between restricting AN-like patients and the controls regarding their motivational orientation toward food was mainly carried by a difference in avoidance tendencies. Compared to the restricting AN patients, the controls showed an enhanced difficulty to move the manikin away from the food pictures, whereas no differences were evident on trials where the task relevant feature required participants to move the manikin towards food. This pattern can not be attributed to a general difference in task performance because there were no differences in responding between both groups during trials depicting neutral (non-food) pictures. It should nevertheless be acknowledged that, in general, participants showed superior performance on trials that required an approach response. This apparent stimulus-independent dispositon to approach rather than to avoid the pictures might have reduced the sensitivity of the present AST-manikin to measure differential approach tendencies. It remains therefore to be seen whether the difference in motivational orientation between restricting AN patients and controls indeed only expresses itself in a differential difficulty to avoid food.

A further limitation of the present study concerns its cross-sectional nature. On the basis of the present data it cannot be determined whether an absence of motivational orientation towards food affects a dysfunctional eating pattern in restricting AN-like patients or whether the absence of approach tendencies is merely a symptom of dysfunctional eating behavior. Future research on motivational orientation in recovered patients would help to arrive at firmer conclusions on this point.

Another methodological aspect that should be mentioned is that before the administration of the AST-manikin two other tasks were administered, as the present study is part of a large scale longitudinal study on cognitive-motivational mechanisms in AN[1]. It can not be ruled out that a differential habituation pattern affected the distracting properties of the task-irrelevant stimulus feature (picture content) in the AST-manikin. However, because such habituation effect would be most pronounced for those participants for whom food items would initially have relatively strong motivational saliency (i.e., the controls), the relatively strong (automatic) approach tendencies that were evident in the controls can not be easily explained by habituation. Additionally, healthy controls tended to report a shorter time since their last meal than restricting AN-like patients, which contradicts the group effect on motivational orientation, and therefore cannot explain the differences in motivational orientation. Still, future research using a balanced order of tasks is necessary to arrive at more final conclusions on this issue.

Another potential limitation of the study is the representability of the low-fat food items. Most stimuli were fruits, which might have influenced the results as fruits typically contain more sugar than low-fat food items such as vegetables. A more representative selection of low-fat food might have lowered approach tendencies towards this category of food-items.

Finally, the generalizability of the present study is limited, as the present study examined motivational orientation in adolescents and not in adults with restricting anorexia nervosa. For example, adolescents with anorexia nervosa probably demonstrate shorter durations of their illnesses than adults with anorexia nervosa which may influence motivational orientation for food. Thus the difference between restricting AN-like patients and controls might even be more pronounced than we found in the present sample of teenagers. It would therefore be interesting to replicate this study in a group of restricting AN-like adults. In addition, it would be important to explore further whether reduced motivational orientation for food is indeed specific for the restricting subtype of anorexia nervosa or can also be found in the binge-purge subtype of AN.

Future research should also focus on the possibility of retraining approach tendencies for food in restricting AN-like patients. Such approach has already been successfully applied to alcohol misuse (Wiers et al., 2010). It would be both theoretically and clinically interesting to see whether retraining approach tendencies could also successfully modify the automatic motivational orientation towards food. Correspondingly, an induced automatic motivational orientation towards food might lead to a favorable change in eating behavior in restricting AN-like patients. Furthermore, it would be important to see whether current treatments lead to a change in the automatic motivational orientation towards food. Possibly, the (residual) absence of motivational orientation could be a predictor for relapse in remitted restricting AN-like patients. Then, indirect measures of motivational orientation may provide a useful diagnostic tool before and after treatment.

Conclusion

The present study showed that in restricting AN-like individuals, presentation of high-fat food items did not elicit the automatic motivational orientation towards food that was evident in healthy individuals. Thus, it seems that (high-fat) food has lost its motivational saliency in restricting AN-like patients, which might help them to restrict their caloric intake. Furthermore, restricting AN-like patients reported fewer food cravings than healthy controls. Thus, the absence of automatic motivational orientation towards food in combination with the deliberate strategy to avoid food could contribute to the persistent character of restricting anorexia nervosa. In the future, retraining methods in motivational orientation for food could offer a useful tool in the change of the (automatic) motivation to eat in (restricting) AN-like patients.

Chapter 4

Attentional Avoidance of High-Fat Food in Unsuccessful Dieters

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Journal of Behavioral Therapy and Experimental Psychiatry (2010, 41, 282-288)

Abstract

Using the exogenous cueing task, this study examined whether restrained and disinhibited eaters differ in their orientation of attention towards and their difficulty to disengage from high versus low-fat food pictures in a relatively short (500 ms) and a long presentation format (1500 ms). Overall, participants in the 500 ms condition showed a tendency to direct attention away from high-fat food pictures compared to neutral pictures. No differential pattern was evident for the 1500 ms condition. Correlational analysis revealed that reduced engagement with high-fat food was particularly pronounced for disinhibited eaters. Although in the short term this seems an adaptive strategy, it may eventually become counterproductive, as it could hinder habituation and learning to cope with seductive characteristics of high-fat food.

Introduction

Eating disordered patients are characterized by evaluating their self-worth in terms of their weight, shape, and eating behavior (Fairburn & Brownell, 2002). Following the cognitive-behavioral model of eating disorders, activation of self-schemata about weight, shape, and eating behavior could disturb information processing in eating disorders (Williamson et al., 2004). Accordingly, a considerable amount of research regarding disturbed information processing focuses on attentional bias for food (see for a review: Faunce, 2002). Attentional bias for food refers to attending differentially towards food-related stimuli in comparison to neutral stimuli. Consistent with the idea that eating disordered patients are preoccupied with food, eating disorder patients may be more attentive to food than healthy individuals. Selective attention for food could be functionally related to an approach-related motivational state (de Jong, Kindt, & Roefs, 2006), which may subsequently be responsible for maintenance of a dysfunctional pattern of eating (Williamson et al., 2004).

Previous studies using the emotional Stroop task consistently found color naming interference for food words compared to neutral words in bulimic patients, and less consistently in anorexic patients and restrained eaters (see for a review: Dobson & Dozois, 2004). However, the use of Stroop tasks in research for attentional bias is debatable, because the color-naming interference effects can be the result of both heightened attention for food related material as well as avoidance of food-related material (De Ruiter & Brosschot, 1994). Therefore, more recent studies used the visual probe strategy that provides more straightforward indices of spatial attention. Underlining the importance to differentiate between approach and avoidance tendencies a recent visual probe study using a 500 ms cue duration showed high-external eaters (i.e., people who tend to overeat when they are exposed to external food cues, for instance smell or sight of food) directed attention away from food words, whereas in contrast low-external eaters directed attention towards food words (Johansson et al., 2004). However, a similar study in external eaters using a 500 ms cue duration showed no differences in attentional biases between groups, whereas in a 2000 ms presentation duration, a stronger attentional bias was found in high-external eaters compared to low-external eaters (Brignell et al., 2009).

The tendency to direct attention towards or away from food stimuli may vary as a function of the type of food items. Accordingly, recent evidence shows that eating disordered patients display attentional bias towards high-caloric eating pictures, whereas they direct attention away from low-caloric eating pictures compared to controls (Shafran et al., 2007). A recent visual search task study revealed similar results. Eating disordered patients were more distracted by high-caloric food words, compared to controls (Smeets et al., 2008). These findings support the view that eating disordered individuals are characterized by enhanced attentional bias towards 'forbidden' foods and are consistent with models implying that attentional bias towards high-fat foods may give rise to problems in the normal regulation of food intake.

Thus far, empirical research has mainly focused on the early stages of information processing. Recent definitions suggest, however, that attentional bias consists of two critical components: attentional engagement and difficulty to disengage. Attentional engagement logically facilitates the detection of 'forbidden' food-items. As a consequence, the individual is continuously reminded of the presence and availability of food. A subsequent inability to disengage attention from food-related cues may induce or enhance craving for 'forbidden' food (Robinson & Berridge, 2003; Franken, 2003). Both attentional processes may contribute in overlapping or distinct ways to cognitive-motivational aspects (craving) and behavioral symptoms of eating disorders (overeating). Thus, both types of processes may inadvertently influence the regulation of food intake and may add to eating disordered individuals' preoccupation with 'forbidden' food.

Because the visual probe test is not well suited to differentiate between attentional engagement and disengagement, we used a modified exogenous cueing task (ECT) that was originally developed by Posner (1980) and modified by Koster et al. (2005). In the ECT, a cue is presented on the left or the right side of a fixation point on a computer screen (see Figure 4.1). After the cue is presented, a target appears at the same or the opposite location on the screen. Participants are instructed to respond as fast and accurately as possible to the location of the target by pressing a left or a right key. A valid trial occurs when the target appears at the same location as the cue, and an invalid trial occurs when the target appears at the opposite location as the stimulus. Participants typically respond faster on valid trials than invalid trials, which is called a normal *cue validity effect*. The *modified* ECT contains both neutral and emotionally relevant cues (that are presented on separate trials) to evaluate the role of attention for emotionally relevant cues compared to neutral cues. The task renders an index of both attentional engagement and attentional disengagement. *Attentional engagement* entails directing attention towards emotionally relevant cues compared to neutral cues. *Attentional disengagement* entails the difficulty to disengage from emotionally relevant cues compared to neutral cues. The modified ECT has already been successfully used in the context of depression (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006). Underlining the importance to differentiate between both components of attentional bias, it was found that depressed patients showed stronger attentional engagement than the non-depressed group for angry faces compared to neutral faces, whereas it was specifically the non-depressed group that shifted attention more rapidly away (attentional disengagement) from the angry faces compared to the neutral faces (Leyman, De Raedt, Schacht, & Koster, 2007).

The present study used a modified ECT to explore the potential role of attentional engagement and attentional disengagement in the context of disordered eating. As a first step to explore the role of attentional biases for the dysregulation of food intake, we investigated an analogue sample of restrained eaters who are people who intend to limit their food intake, but frequently fail and indulge in exactly the foods they want to avoid (Herman & Polivy, 1980), and a control group of unrestrained eaters (i.e., people who do not try to limit their food intake). Restrained eating not only refers to actual dieting, but also to the intention to diet. To gain insight in the time course of both components of attentional bias as function of group, we used a relatively short as well as a relatively long presentation duration. Following previous research that was designed to test the differential role of attentional vigilance and avoidance in the context of threatening stimuli (Mogg et al., 2004), we used a stimulus presentation duration of 500 ms and of 1500 ms. The expression of attentional bias with 500 ms presentation duration can be considered as initial orientation toward food, and represents initial shifts towards or away from food (Bradley, Mogg, & Millar, 2000). A longer presentation duration (e.g., 1500 ms) may provide an indication of subsequent sustained attention to or avoidance of food

(Mogg et al., 2004). Possibly, restrained eaters show enhanced vigilance for high-fat foods, which may complicate their attempts to restrict their food intake. Previous work in the context of addiction showed that substance misusers are not only characterized by initial vigilance but also by a maintained attention for drug-cues (for a review see Field, Mogg, & Bradley, 2006). This pattern of sustained attention could reinforce the generation of craving, which in turn will lower the threshold for substance misuse (cf. de Jong et al., 2006). In a similar vein, difficulties with directing attention away from 'forbidden' foods may oppose the intended restriction of food-intake in restrained eaters thereby contributing to the dysregulation of their eating behavior and their preoccupation with high-fat food.

Most studies of attentional bias for food have used verbal stimuli. However, pictorial food stimuli may provide a more ecologically valid representation of food. Moreover, pictures have more direct access to the semantic system, which contains affective information. Therefore, pictures are assumed to be more strongly related to affective information than words (De Houwer & Hermans, 1994). In the context of smoking, for example, smoking-related pictures automatically elicited positive affective responses in regular smokers (Huijding & de Jong, 2006a), whereas smoking-related words did not (Huijding, de Jong, Wiers, & Verkooijen, 2005). Therefore, the present study used pictures rather than words in an attempt to optimize the sensitivity of the present design to find meaningful food-related attentional biases in restrained eaters.

Method

Participants

At a mass-testing session, all first year female psychology students (n = 481) at the University of Groningen completed the Restraint Scale (RS; Herman & Polivy, 1980; Thomas et al., 2009). Twenty-eight participants were classified as restrained eaters, indicated by scoring in the highest quartile, a score of 14 or higher on the RS (Body Mass Index: M = 24.5; SD = 4.3; *range* = 19.6 – 34.4). Twenty-seven participants were classified as unrestrained eaters, indicated by scoring in the lowest quartile, a score of 7 or lower on the RS (Body Mass Index: M = 20.8; SD = 2.0, range = 17.2 – 25.8). The Body Mass Index indicates the ratio of weight to squared height (kg/m^2). Table

4.1 shows participants' characteristics. The two groups did not differ significantly in age, $t(53) = 1.58$, $p > .05$. However, they did differ in BMI, $t(53) = 4.01$, $p < .001$. During the day of the experiment participants also completed the Dutch Eating Behavior Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986; Thomas et al., 2009). Supporting the validity of the selection procedure, restrained eaters scores higher on the Restraint subscale than the unrestrained eaters, $t(53) = 8.84$, $p < .05$. In addition, the restrained group scored higher on the disinhibition subscale, $t(53) = 3.37$, $p < .05$.

Table 4.1: Participants' characteristics

	Group							
Characteristics	Unrestrained eaters				Restrained eaters			
RS	4.81		(1.92)		16.46		(2.98)	
DEBQ – Restraint	1.82		(0.61)		3.29		(0.62)	
DEBQ – Disinhibition	2.68		(0.40)		3.06		(0.44)	
BMI	20.83		(1.99)		24.47		(4.28)	
Hunger Scale	3.06		(0.64)		3.11		(1.17)	
Visual Analogue Scales (0–100)	High-fat food		Low-fat food		High-fat food		Low-fat food	
Palatibility	78.87	(11.45)	78.26	(8.01)	78.46	(9.18)	76.04	(9.12)
Liking / tastiness	82.75	(12.37)	80.45	(10.65)	84.75	(7.76)	82.54	(8.73)
Craving	60.71	(25.79)	60.62	(17.53)	55.39	(17.91)	58.70	(16.39)
Frequency of eating	56.62	(13.10)	48.13	(13.64)	52.91	(11.94)	46.92	(14.68)

Note. Mean characteristics, with *SD* in parentheses. RS = Restraint Scale (Herman & Polivy, 1980); DEBQ = Dutch Eating Behavior Questionnaire (Van Strien et al., 1986); BMI = Body Mass Index.

Measures

A modified exogenous cueing task (ECT) was used to measure attentional bias for food cues (Koster et al., 2005). The ECT was programmed in E-prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002) and run on a Windows XP computer with a 22 inch CRT monitor (resolution set to 1024 by 768 pixels).

During each trial, two rectangles (9.8 cm high and 12.3 cm wide) were presented side by side on a grey-colored background, with a fixation cross presented in the middle of the screen (see Figure 4.1 for an example of a trial). The middle of the rectangles was 9.2 cm (visual angle: 8.7º) from the fixation cross. Cues and targets were presented in the middle of the rectangles. Targets were grey squares (1.25 cm by 1.25 cm). Picture cues had the same size as the white rectangles.

Responses were made by pressing one of two keys, labeled *left* and *right*, on a response box.

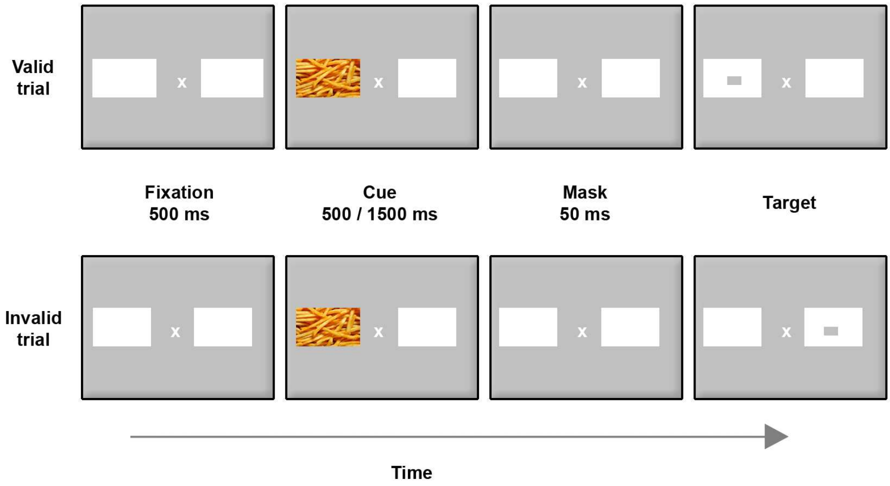

Figure 4.1: Example of a valid and an invalid trial in the Exogenous Cueing Task.

Each trial started with a 500 ms presentation of the fixation cross and the two white rectangles. Next, a picture cue appeared during 500 ms or 1500 ms. The duration of the presentation of the picture cue was balanced over participants, half of the participants received the 500 ms and half the 1500 ms presentation duration to avoid carry-over effects. The target was presented 50 ms after cue offset and disappeared after a response was made. The following trial started immediately after the response.

The exogenous cueing task consisted of a practice block of twelve trials, followed by two test blocks of 90 trials. Each picture was presented four times to the participant (twice as valid trials: left cue – left target and right cue - right target; and twice as invalid trials: left cue – right target and right cue – left target). Furthermore, there were ten “no cue trials” that were included with the intention to create a baseline score. However, because participants responded systematically slower on no cue than on regular trials, no cue trials eventually proved to be unsuitable as baseline, and were excluded from analysis (Koster et al., 2005). The trials were presented in a new random order to each participant.

Stimulus selection

Stimulus selection was based on a study on the evaluation of high-fat and low-fat foods (Roefs et al., 2005a). Cues consisted of five high-fat food pictures (e.g., pizza, chocolate, croissant), five low-fat food pictures (e.g., strawberries, grapes, melon) and ten neutral pictures derived from the International Affective Picture System (IAPS, 1995).

Procedure

At the beginning of the experiment, participants conducted the modified ECT (Koster et al., 2005). The participants were seated at 60 cm viewing distance from the computer screen to perform the task. Participants were asked to respond as quickly and accurately as possible to the location of the target by pressing the corresponding key on the response box.

After the cueing task the participants were asked to answer four questions using visual analogue scales. Participants assessed the palatibility of the foods by answering the question 'To what extend does this food appear palatable to you?' on a scale from 'unpalatable' to 'palatable'. Food stimuli were rated on liking using the question 'How much do you like this product', which was answered on a scale from 'don't like it at all' to 'like it very much'. Craving was assessed using the question: 'How much do you crave for this product at this moment?', which was answered on a scale from 'not at all' to 'very much'. Furthermore, the participants were asked to assess the frequency with which they ate the particular food using the question 'How frequently do you eat this food', which was answered on a scale from 'never' to 'very often'. Next, participants were asked to fill out the Hunger Scale (Grand, 1968), and the Dutch Eating Behavior Questionnaire (DEBQ). The DEBQ consists of three subscales: restrained, emotional and external eating. Combination of the latter two subscales provides a measure of disinhibited eating, which refers to a failure of restraining food intake (Van Strien et al., 1986). Furthermore, participants were asked to fill out the RS (Herman & Polivy, 1980) again to ensure the reliability of our selection.

Results

Group characteristics

Restrained and unrestrained eaters did not differ with respect to their assessment of the palatibility of high-fat food, $t(53) = 0.15$, $p > .1$, and low-fat food, $t(53) = 0.96$, $p > .1$. They did also not differ in how much they reported to like high-fat food, $t(53) = 0.72$, $p > .1$, and low-fat food, $t(53) = 0.80$, $p > .1$. At the moment of testing, restrained and unrestrained eaters did not differ in their reported craving for high-fat food, $t(46) = 0.89$, $p > .1$[7], and low-fat food, $t(53) = 0.42$, $p > .1$. Restrained and unrestrained eaters did not differ in their self-reported frequency with which they ate high-fat food, $t(53) = 1.10$, $p > .1$, and low-fat food, $t(53) = 0.32$, $p > .1$. Furthermore, restrained and unrestrained eaters did not differ with respect to their motivational state of hunger, $t(53) = 0.20$, $p > .1$ (see Table 4.1 for *M*'s and *SD*'s). Pretest and posttest measures of the RS did not differ, $t(53) = 1.02$, $p = .31$, and showed high test-retest reliability, $r = .91$.

Exogenous Cueing Task

Following the procedure described by Koster (2005), trials of the ECT with errors (2.3%) and trials with reaction times below 200 ms and above 750 ms (4.8%) were excluded from analyses. Restrained and unrestrained eaters did not differ with respect to their number of errors, $t(53) = 0.81$, $p > .1$, $d = .22$. Data were analyzed using a 3 (cue type: high-fat food, low-fat food, or neutral pictures) x 2 (cue validity: invalid or valid) x 2 (group: restrained or unrestrained eaters) x 2 (presentation duration: 500 ms or 1500 ms) mixed models analysis of variance with the first two factors being within-subjects factors. If the relevant interactions were significant, the effects were further analyzed by calculating cue validity effects to examine maintained attention to cues, and attentional engagement as well as attentional disengagement scores to examine the exact attentional processes that were involved (e.g., Koster et al., 2005). Cue validity effects were calculated by subtracting the valid scores from the invalid scores. The emotional modulation of attentional engagement and disengagement are calculated as follows:

Attentional engagement = RT valid neutral cue – RT valid food cue

[7] Through lack of equality of variances, adapted degrees of freedom were used.

Attentional disengagement = RT invalid food cue – RT invalid neutral cue

Positive scores on attentional engagement are indicative of directing attention towards the food cues compared to the neutral cues. Positive scores on attentional disengagement indicate a difficulty to disengage from food cues compared to neutral cues. In terms of RTs: if in valid trials the response to food stimuli is faster than the response to neutral stimuli, this points to attentional engagement, whereas if in invalid trials the response to food stimuli is slower than to neutral stimuli, this is indicative of a difficulty to disengage attention from food stimuli.

All effects are reported as significant at $p < 0.05$. Effect-sizes are also reported using partial eta-squared (η_p^2; small: 0.01, medium: 0.06, and large effect: 0.14 (Cohen, 1977)) or Cohen's d (small: 0.20, medium: 0.50, and large effect: 0.80 (Cohen, 1992)).

Overall effects. Most importantly, a medium sized presentation duration x validity x cue type interaction effect was found, $F(2, 102) = 2.97$, $p = .05$, $\eta_p^2 = .06$. This pattern was similar for both groups, as is apparent from the non-significant four-way interaction, $F(2, 102) = 1.3$, $p > .2$, $\eta_p^2 = .02$. To interpret this three-way interaction effect, we first examined for each presentation duration whether the validity x cue type interaction reached significance. Then, we calculated the cue validity effects, attentional engagement scores and the attentional disengagements scores.

Table 4.2: Response latencies as a function of group, cue type and cue validity; and cue validity effects, attentional engagement scores and attentional disengagement scores as a function of cue type in the 500 ms condition.

	High-fat food		Low-fat food		Neutral pictures	
	Invalid	Valid	Invalid	Valid	Invalid	Valid
Response latencies						
Group						
Unrestrained eaters ($n = 27$)	288 (38)	294 (32)	288 (33)	283 (27)	289 (35)	283 (35)
Restrained eaters ($n = 28$)	275 (18)	282 (27)	273 (20)	272 (20)	282 (22)	275 (19)
Cue validity effects	-6.2 (18.1)		3.1 (18.8)		6.2 (12.4)	
Attentional engagement scores	-8.8 (12.2)		1.5 (12.0)			
Attentional disengagement scores	-3.6 (13.7)		-4.5 (12.1)			

Note. Mean response latencies (in ms), with *SD* in parentheses.

500 ms condition. Response latencies as a function of cue type, cue validity, and group for the 500 ms condition are presented in Table 4.2. The 3 (cue type: high-fat food, low-fat food or neutral pictures) x 2 (cue validity: invalid or valid) x 2 (group: restrained or unrestrained eaters) mixed ANOVA showed a main effect of cue type, $F(2, 54) = 4.43$, $p < .05$, $\eta_p^2 = .14$. As can be seen in Table 4.2, this reflects the finding that participants were generally faster in their responding during low-fat food trials than during either neutral or high fat food trials. Most important for the present context, this main effect was qualified by the predicted cue type x validity interaction, $F(2, 54) = 7.20$, $p < .01$, $\eta_p^2 = .21$, indicating that the cue validity effect varied as a function of stimulus type.

A normal cue validity effect was found for trials containing neutral cues, $t(27) = 2.6$, $p < .05$, $d = .22$. Participants were faster on valid than on invalid trials. High-fat food trials showed a tendency in the opposite direction, $t(27) = 1.82$, $p = .08$, $d = .21$, whereas there was no significant cue-validity effect for low-fat food trials, $t(27) = 0.87$, $p > .1$, $d = .12$. The cue validity effect of the high-fat food trials differed significantly from the cue validity effects of the low-fat food, $t(27) = 2.74$, $p < .05$, $d = .50$, and the neutral condition, $t(27) = 3.36$, $p < .01$, $d = .80$. This indicates that participants tended to direct attention away from high-fat food, which resulted in a reverse cue validity effect.

Participants showed negative attentional engagement scores for high-fat food trials that were significantly different from zero, $M = -8.8$ ms, $t(27) = 3.80$, $p < .01$, $d = 1.35$, indicating that there was slower attentional engagement with high-fat food cues compared to neutral cues. Engagement scores for low-fat food trials did not differ from zero, $M = 1.5$ ms, $t(27) = 0.64$, $p > .1$, $d = .12$. There was slower attentional engagement with high-fat food than with low-fat food cues, $t(27) = 3.33$, $p < .01$, $d = .84$.

For both high-fat food trials and low-fat food trials participants displayed negative disengagement scores suggesting that more time was required to shift attention away from neutral than from food stimuli (-3.5 ms and -4.5 ms, respectively). However, for neither the high-fat nor the low-fat food stimuli the disengagement score reached significance, $t(27) = 1.38$, $p = .18$, $d = .26$ and $t(27) = 1.97$, $p = .06$, $d = .63$, respectively.

1500 ms condition. No interaction effects were found in the 1500 ms condition. No evidence was found for prolonged attentional engagement for food in restrained and unrestrained eaters. The 3 (stimulus valence: high-fat food, low-fat food or neutral pictures) x 2 (cue validity: invalid or valid) x 2 (group: restrained or unrestrained eaters) mixed ANOVA only revealed a main effect of validity, $F(1, 25) = 10,46$, $p < .01$, $\eta_p^2 = .30$. Participants responded faster on valid trials than on invalid trials, indicating a normal cue validity effect. This effect appeared independent of cue type, $F(2, 50) = .57$, $p > .1$, $\eta_p^2 = .02$. Thus, during relatively long stimulus presentation (1500 ms) no differential attentional processes for food were evident in restrained and unrestrained eaters.

Other overall effects. The overall analysis also revealed a significant main effect of presentation duration, $F(1, 51) = 7.10$, $p < .05$, $\eta_p^2 = .12$. Participants responded faster on trials in the 500 ms condition ($M = 282.0$) than in the 1500 ms condition ($M = 301.1$). There was also a significant main effect of validity, $F(1, 51) = 8.85$, $p < .01$, $\eta_p^2 = .15$, indicating that participants had overall faster responses to valid trials than to invalid trials. The main effect of validity sustains the validity of the task. The analysis did also show a borderline significant main effect of group, $F(1, 51) = 3.90$, $p = .05$, $\eta_p^2 = .07$. Overall restrained eaters tended to respond faster than unrestrained eaters. No main effect of cue type was found, $F(2, 102) = 0.46$, $p > .1$, $\eta_p^2 = .01$.

Post-hoc correlational analysis

To further explore the relationship between eating behavior and attentional bias in the 500 ms condition, we also executed a post-hoc correlational analysis. Because the RS that was used to select participants may reflect both inhibited as well as disinhibited eating (Soetens, Braet, Dejonckheere, & Roets, 2006), we computed Pearson's p-m correlations between the indices of attentional bias (cue validity effects, attentional engagement and attentional disengagement) on the one hand and restrained eating (DEBQ Restraint, Van Strien et al., 1986) and disinhibited eating (DEBQ Disinhibition, Van Strien et al., 1986) on the other hand. Correlational analysis allows the maintenance of the continuity of the scores on dieting thereby retaining optimal power to detect differential patterns of attentional bias as a function of both successful and unsuccessful dieting. The scores of both scales were normally distributed (DEBQ Disinhibition: skewness/se = .27; kurtosis/se = .40, DEBQ Restraint: skewness/se = .03; kurtosis/se = 1.54; cf. Tabachnik & Fidell, 1996). See Table 4.3 for an overview of the correlations.

Attentional engagement and cue validity effects. A negative correlation was found between the attentional engagement scores for high-fat food and DEBQ Disinhibition, indicating that the higher participants score on DEBQ Disinhibition, the less engagement with high-fat food cues. A similar pattern is evident for the cue validity effects converging to the interpretation that disinhibited eaters tend to direct attention away from food. No relationship was found between the attentional engagement scores or cue validity effects of both the high-fat food cues and the low-fat food cues and the DEBQ Restraint. Restraint status seemed not to affect the allocation of attention towards food stimuli.

Table 4.3: Correlations between subscales of restrained and disinhibited eating and cue validity scores, engagement scores and disengagement scores of different cue types in the 500 ms condition (n = 28).

	DEBQ – Disinhibition	DEBQ - Restraint
Cue validity effects		
High-fat food	-0.51**	-0.23
Low-fat food	-0.50**	-0.14
Neutral pictures	-0.18	-0.03
Engagement scores		
High-fat food	-0.37*	0.12
Low-fat food	-0.12	0.08
Disengagement scores		
High-fat food	-0.18	-0.38*
Low-fat food	-0.48**	-0.27

Note. DEBQ = Dutch Eating Behavior Questionnaire (Van Strien et al., 1986).
*p < .05
**p < .01

Attentional disengagement. There was a negative correlation between disengagement scores of high-fat food pictures and DEBQ Restraint. This indicates that participants scoring high on DEBQ Restraint more easily disengage from high-fat food pictures compared to neutral pictures. The DEBQ Disinhibition revealed a roughly similar pattern of facilitated disengagement from food stimuli.

Summarizing, participants scoring high on DEBQ Disinhibition show less attentional engagement with high-fat food cues. Participants scoring high on DEBQ Restraint show more disengagement from high-fat food cues.

Discussion

The present study investigated whether restrained eaters are characterized by enhanced engagement for and/or an impaired disengagement from food stimuli. The main results can be summarized as follows: in the relatively short stimulus presentation (500 ms) (i) restrained and unrestrained eaters showed a pattern of initial avoidance of high-fat food compared to neutral stimuli; (ii) restrained eaters and unrestrained eaters displayed slower attentional engagement with high-fat food stimuli compared to neutral stimuli; (iii) correlational analysis indicated that disinhibited eaters showed slower attentional engagement for high-fat food, whereas no evidence was found for a difficulty in disengagement from high-fat food in disinhibited eaters. During relatively long stimulus presentation (1500 ms) (iv) no differential attentional processes were evident.

Interestingly, restrained and unrestrained eaters showed avoidance of high-fat foods during the short presentation duration, whereas there was no avoidance of low-fat foods. In a similar vein, restrained and unrestrained eaters showed less engagement for high-fat foods, whereas there was no reduced engagement for low-fat foods. So unexpectedly, restrained eaters did not display enhanced engagement for high-fat food. The tendency to display less attentional engagement with and/or direct attention away rather than towards ‘forbidden’ foods is consistent with their explicit motivation to avoid eating high-fat food. However, this pattern was not unique for restrained eaters. Apparently, unrestrained eaters have a common strategy to avoid high-fat food in an early stage of attention. For a proper appreciation of this finding, it is important to note that we used a stimulus presentation duration of 500 ms to test the presence of enhanced vigilance for visual food cues (cf., Mogg et al., 2004). It should be acknowledged that with a presentation duration of 500 ms, shifts of attention are possible. Thus, if an attentional bias is observed, this might reflect maintained attention instead of initial vigilance (e.g., Field & Cox, 2008). Therefore, it can not be ruled out that the restrained (and/or unrestrained) in this experiment did initially orient their attention automatically towards high-fat food stimuli, but subsequently tried to avoid the pictures (e.g., as a cognitive strategy to reduce craving and prevent disinhibited food intake). In that case, the observed avoidance of high-calorie foods might reflect a secondary cognitive strategy instead of an initial automatic process. To arrive at more final conclusions in this respect it would be important to replicate this study by adding an even shorter presentation duration (e.g., 200 ms).

The apparent absence of differences in attentional bias between restrained eaters and unrestrained eaters is consistent with previous research using a (500 ms) dot probe methodology (Boon, Vogelzang, & Jansen, 2000). As the effect size of the relevant interaction was negligible, it seems not very likely that the absence of a group difference should be attributed to insufficient power of the present study. Another and theoretically more interesting explanation could be that the group of restrained eaters as indexed by the RS is heterogeneous in their ability to control food intake. There is evidence that individuals scoring high on the RS may comprise of both successful and unsuccessful dieters (Soetens et al., 2006), and food cues may elicit different attentional processes in these so-called inhibited versus disinhibited restrainers.

In accordance with the importance to distinguish between inhibited and disinhibited eaters, correlational analyses revealed that disinhibited eaters showed less attentional engagement with food than inhibited eaters. This finding is consistent with earlier research showing that individuals whose eating is easily triggered by food-relevant stimuli irrespective of hunger (i.e., external eating as defined by Van Strien et al., 1986) also tended to direct their attention away from food stimuli (Johansson et al., 2004). Although a pattern of attentional avoidance of food provides no indication that attentional bias for food plays an important role in the pathogenesis of disinhibited eating, a pattern of avoidance of food seem to reflect disinhibited eaters' explicit strategy to restrict their food intake. However, repeated periods of prolonged deprivation may enhance the reward value of food (cf. Brown, Jackson, & Stephens, 1998). Therefore, it can not be ruled out that in the long run, the seemingly highly adaptive strategy to direct attention away from 'forbidden' food may become counterproductive and may be associated with disinhibited eating patterns.

In addiction, current approaches assume that there is a reciprocal relationship between craving and "attentional bias" (Franken, 2003). In line with this view, it has even been argued that the development of attentional bias for drug stimuli may be the core process underlying craving and compulsive-drug-use

(Lubman et al., 2000). Attentional bias could conceivably play a similar role in craving for food and over-eating. Accordingly, for disinhibited eaters, their tendency to attentionally avoid food items may be considered as an adaptive strategy, as it may prevent the generation of craving for ‘forbidden’ food. However, when a context increasingly activates craving (i.e., if a context also contains features of smell, sight and/or availability of food), this may reduce avoidance of attentional engagement with food, by which the process could change into enhanced attentional engagement with food. In turn, heightened attention for food could intensify craving, and may lead to food intake. One way to test this would be to see whether manipulation of craving will lead to enhanced attentional engagement with food in disinhibited eaters, and whether this in turn will lead to increased food intake.

No effects were found for attentional disengagement from food in restrained eaters. Contrary to expectations, restrained eaters did not seem to have difficulty to disengage their attention from food. Possibly, problems in disengagement attention from food occur in shorter stimulus presentation formats. Consistent with this argument, no evidence was found at longer stimulus presentation duration (1500 ms) for impaired attentional disengagement and/or attentional avoidance.

To the best of our knowledge, no study thus far has investigated attentional engagement and disengagement for food using the modified ECT, so replication of these findings will be needed. Future research should further investigate the correlation between attentional bias for food and disinhibited eating by selecting the sample on the basis of disinhibited eating. In addition, it would be important to see whether the present results can be generalized to clinical samples of anorexia nervosa and bulimia nervosa patients. In anorexia nervosa patients, for example, a vigilance-avoidance pattern for food could be expected, like attentional bias studies in fear patients (e.g., Mogg et al., 2004). In bulimia nervosa and binge eating disorder patients, enhanced vigilance and maintained attention for food might be involved, similar to the attentional pattern in addiction (e.g., Field, Mogg, Zetteler, & Bradley, 2004).

An important limitation of the present study concerns its correlational nature. On the basis of the present data it can not be decided whether reduced attentional engagement affects dysfunctional eating patterns in disinhibited eaters or whether attentional bias is just an epiphenomenon. One way to test the alleged causal role of attentional bias would be to train attentional bias for food in a healthy group to see whether an individual would report more eating-disorder-related concerns, as two recent studies did for attentional bias for body and shape-related words (Engel et al., 2006; Smith & Rieger, 2006). Another potential limitation of the present approach concerns the possibility that the mere presentation of valent cues (such as food stimuli) may give rise to a general response interference effect that can compromise the distinction between attentional engagement and disengagement indices (Mogg, Holmes, Garner, & Bradley, 2008). However, because no main effects of cue type were observed on response latencies, such potential interference effect seems not involved in the present study. Finally, building on previous work testing the vigilance-avoidance hypothesis in the context of threat using complex visual cues, we used a 500 ms cue duration to assess initial orientation. Because such stimulus presentation duration allows for the occurrence of multiple shifts in attention, it would be important for future research to use even shorter presentation durations (e.g., 200 ms) to examine potential differences between restrained and unrestrained eaters in earlier stages of attention.

Conclusion

In sum, people generally show avoidance and less engagement for high-fat food during early stages of attention. Avoidance and reduced engagement for high-fat food did particularly apply for disinhibited eaters. It remains to be tested whether disinhibited eaters hold on to this pattern of avoidance in potentiated contexts (cf., Hepworth et al., 2010) and whether this pattern of avoidance reflect an initial automatic process or a secondary cognitive strategy (e.g., to counteract cue-elicited craving).

Chapter 5

Attentional Bias in Restrictive Eating Disorders: Stronger Attentional Avoidance of High-Fat Food Compared to Healthy Controls?

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(accepted manuscript)

Abstract

A striking feature of the restricting subtype of anorexia nervosa (AN) is that these patients are extremely successful in restricting their food intake. Possibly, they are highly efficient in avoiding attentional engagement of food cues, thereby preventing more elaborate processing of food cues and thus subsequent craving. This study examined whether patients diagnosed with restrictive eating disorders ('restricting AN-like patients'; N = 88) indeed show stronger attentional avoidance of visual food stimuli than healthy controls (N = 76). Attentional engagement and disengagement were assessed by means of a pictorial exogenous cueing task, and (food and neutral) pictures were presented for 300 ms, 500 ms, or 1000 ms. In the 500 ms condition, both restricting AN-like patients and healthy controls demonstrated attentional avoidance of high-fat food as indexed by a negative cue-validity effect and impaired attentional engagement with high-fat food, whereas no evidence was found for facilitated disengagement from high-fat food. Within the group of restricting AN-like patients, patients with relatively severe eating pathology showed relatively strong attentional engagement with low-fat food. There was no evidence for attentional bias in the 300 ms and 1000 ms condition. The pattern of findings indicate that attentional avoidance of high-fat food is a common phenomenon that may become counterproductive in restricting AN-like patients, as it could facilitate their restricted food intake.

Introduction

According to the cognitive-behavioral theory of eating disorders, patients with anorexia nervosa (AN) are characterized by self-schemata that relate to body shape and eating. These self-schemata are presumed to lead to a preoccupation with body- and food-related information, and affect several cognitive processes, like the allocation of attention for body parts and food types. (Williamson et al., 2004). Attentional avoidance of body- and food-related information could help AN patients to restrict their food intake. Accordingly, a considerable amount of research regarding disturbed information processing focuses on attentional bias for food (see for a review: Faunce, 2002; Dobson & Dozois, 2004).

Attentional bias for food in AN has been studied using several techniques. Previous studies using the emotional Stroop task found mixed evidence for color-naming interference for food words compared to neutral words in AN patients and restrained eaters (see for a review: Dobson & Dozois, 2004; Johansson et al., 2005; Brooks, Prince, Stahl, Campbell, & Treasure, 2011). However, the use of Stroop tasks in research for attentional bias is debatable, because the Stroop task does not provide an adequate measure of attentional allocation. Color-naming interference effects for food can be the result of both heightened attention for food-related material as well as avoidance of food-related material (De Ruiter & Brosschot, 1994), which make Stroop studies difficult to interpret in terms of attentional bias.

More recent studies used the visual probe strategy that provides more straightforward indices of spatial attention. In a typical visual probe study the participant is presented with two stimuli, followed by a target stimulus (i.e., probe) on the location of one of the stimuli. The participant has to respond to the location of the probe. The basic idea is that the response is facilitated when the participant's attention was allocated to the location of the probe. Attentional bias for food can be measured by reaction times to the target in which relatively fast reactions to targets that replace food words compared to targets that replace neutral words are indicative of attentional bias for food. Furthermore, the presentation time of the stimuli can be modified to examine the role of enhanced engagement (short presentation duration, e.g., 300 ms) and maintained attention (long presentation duration, e.g., 1000 ms).

Only two visual probe studies are conducted on attentional bias for food in patients with clinically diagnosed eating disorders (Shafran et al., 2007; Shafran et al., 2008), and used a presentation duration of 1000 ms. Both studies consistently found that eating disorder patients showed a tendency to direct their attention towards negative eating pictures (i.e., high calorie food in uncontrolled circumstances) and a tendency to direct attention away from positive eating pictures (i.e., low calorie food in controlled circumstances). However, the previous studies on attentional bias for food in eating disorders did not differentiate between different eating disorder diagnoses (e.g., AN purging type, AN restricting type, BN, Binge Eating Disorder (BED), or other ED-NOS). Due to the relatively small number of AN patients it cannot yet be decided whether the pattern of an attentional bias for negative eating pictures also applies for (restrictive) AN. Possibly, attentional avoidance could be found in a restrictive AN sample.

Furthermore, current definitions suggest that attentional bias consists of three critical components: initial shift of attention, attentional engagement, and attentional disengagement (Posner, 1980). An initial shift of attention or attentional engagement could be involved in attentional bias by an earlier allocation of attention towards food (early vigilance and faster detection) compared to neutral objects. Attentional disengagement could be involved in attentional bias by a difficulty to disengage from food compared to neutral objects. Early vigilance and attentional engagement would particularly be found in early stages of attention (e.g., 300 ms after exposure to food cues). A difficulty to disengage from food could occur directly after attentional engagement took place. Biases in all of these components may add to eating disordered individuals' preoccupation with food and may inadvertently influence the restriction of food intake. Possibly, patients diagnosed with the restrictive subtype of AN show initial attentional avoidance and/or weak engagement of (high-fat) food, and a facilitated disengagement from (high-fat) food, which may jointly contribute to their restricted eating pattern. Unfortunately, the visual probe paradigm that was used in previous studies on attentional bias does not allow to differentiate between these components of attentional bias. Therefore, a recent attentional bias study used a visual search task to measure speeded detection and increased distraction in eating disordered patients. On part of the trials, participants had to search for the single food-related word in an array of neutral words (i.e., speeded detection), whereas on the other part of the trials they had to search for the single neutral word in an array of food-related words (i.e., increased distraction). Results indicated that eating disordered patients were relatively slow on trials where they had to find the neutral word among high-caloric food words (increased distraction), compared to controls (Smeets et al., 2008). No differences were found between different eating disorder diagnoses (22 AN-restrictive, 24 AN-purging, 22 BN patients). Unfortunately, speeded detection and attentional engagement as well as increased distraction and attentional disengagement are not exactly the same constructs. For example, during the critical trials of the visual search task a neutral word is always presented in an array of food-related words, so the relatively slow detection of a neutral word in a food-array might not so much be caused by a difficulty to disengage, but by a repeated distraction by the food-related words (i.e., multiple attentional shifts).

Together the available evidence seems to suggest that eating disorder patients are characterized by heightened attention for food (see for a review: Brooks et al., 2011). However, it is still unclear whether these results also apply to AN, and how the components of attentional bias for food are involved within this group. Perhaps similar to attentional bias studies in phobic anxiety (e.g., Mogg et al., 2004), AN patients may show a vigilance-avoidance pattern related to food items, in which vigilance for food contributes to detect food in an early stage combined with avoidance of thorough processing of food aspects that might help to subsequently avoid (the intake of) food. In support of this, functional imaging studies showed down regulation of cerebral areas in AN (and BN) patients when they viewed food pictures, which can be interpreted as disengagement from food (see for a review: Giel et al., 2011). To test further the role of attentional bias in AN, the present study focused on restricting AN-like patients who were referred to a specialized clinic for eating disordered patients.

The present study used the modified exogenous cueing task (ECT) originally developed by Posner (1980). The ECT is well-suited to differentiate between processes of attentional engagement with and attentional disengagement from emotionally relevant stimuli and has been shown to be sensitive to individual differences (Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2005). The original ECT employed verbal stimuli. In the present study, however, we used pictures instead of words to improve the ecological validity of the task.

In the pictorial version of the ECT, the participant is continuously presented with a fixation point in the middle of a computer screen. During the task, a cue (i.e., picture) appears on the left or the right side of the computer screen. The picture disappears and a target (i.e., small square figure) appears on the left or the right side. The participant is instructed to fixate the eyes on the fixation dot in the middle of the screen and to respond as quickly as possible to the location of the target by pressing the left or the right key on a response box. When the target and the cue appear on the same location, it is called a valid trial. When the target and the cue appear at different locations, it is called an invalid trial (see Figure 5.1 for an example of a valid and an invalid trial). Typically, participants respond faster to valid trials than to invalid trials, because the attention is still on the side of the cue, which facilitate the response to the target. This effect is called a normal cue validity effect. In the modified ECT, however, the participant is presented with neutral cues as well as emotionally relevant cues (i.e., body shape or food in the context of eating disorders), which enables a comparison between attention for this emotionally relevant and neutral information. The use of both neutral and emotionally relevant cues provides the opportunity to measure the processes of attentional engagement and disengagement. Attentional engagement comprises facilitated responses to emotionally relevant cues compared to neutral cues on valid trials, and slowed disengagement comprises delayed responses to emotionally relevant cues compared to neutral cues on invalid trials.

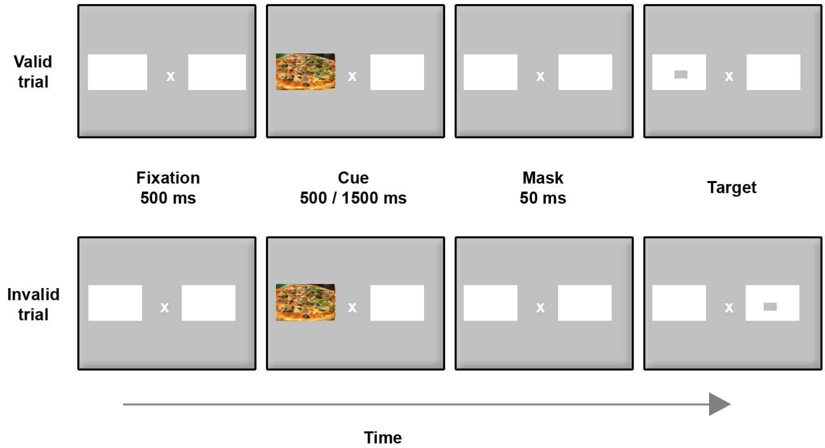

Figure 5.1: Example of a valid and an invalid trial in the Exogenous Cueing Task.

As mentioned before, the pattern of attentional deployment can vary over time, and various presentation times have to be used to distinguish between early vigilance and more maintained attention. Therefore, pictures were presented for 300 ms, 500 ms, or 1000 ms duration to allow for a more detailed investigation of the attentional deployment over time. A previous study using the ECT to examine attentional bias for food showed that when pictures were presented for 500 ms, relatively strong avoidance of high-fat food was found in unsuccessful dieters (Veenstra et al., 2010). We hypothesized that restricting AN-like patients initially (i.e., 300 ms) would show heightened attention for food as indexed by a positive cue-validity effect, enhanced engagement and/or a difficulty to disengage, and subsequently (i.e., 500, 1000 ms) a pattern of avoidance of food as indexed by a negative cue-validity effect, impaired engagement and facilitated disengagement. As high-fat food is most relevant when it comes to the restriction of caloric intake, we examined whether the attentional bias would be restricted to high-fat food or would also be evident for low-fat food items.

Method

Participants

All patients who were admitted to the Department of Eating Disorders of Accare in Smilde were diagnosed by the Eating Disorder Examination (EDE; Bryant-Waugh et al., 1996; Dutch version: Decaluwé & Braet, 1999) within two weeks after admission.

A group of restrictive eaters was selected by including a group of broadly defined AN-like patients (*N* = 88). Accordingly, we included female patients who met criteria of the restrictive type of AN (n = 40). In addition, we included female patients who met criteria of AN subgroups of Eating Disorder Not Otherwise Specified (EDNOS; n = 48). For these AN-like subgroups, we selected patients who met criteria of AN with menses (i.e., all AN criteria except amenorrhea; n = 14), high-weight AN (i.e., all AN criteria except BMI > 17.5; n = 16), non-fat phobic AN (i.e., all AN criteria except intense fear of weight gain; n = 4), and partial AN (i.e., presents with features of AN, but miss 2 or more criteria of AN; n = 14; cf., Thomas, Vartanian, & Brownell, 2009). Control group participants (n = 76) were matched on age and education and were selected from the Gomarus College, a secondary school in Groningen. See Table 5.1 for a description of both groups of participants. Eating disordered patients and healthy controls did not differ with respect to their educational level, $\chi2(1) = .55$, $p > .1$, or their age, $t(162) = .40$, $p > .1$, $d = .07$.

Table 5.1: Group characteristics

	Restricting AN-like patients *(n = 88)*		Healthy controls *(n = 76)*		Between-groups test	
	M	*SD*	*M*	*SD*	*F*	*p*
Education[8]						
Low-level	*(n = 29)*		*(n = 25)*			
Age	14.41	2.08	14.32	1.46	0.36	.851
High-level	*(n = 46)*		*(n = 51)*			
Age	15.02	1.37	15.12	1.75	0.09	.766
Underweight (%)	19.79	9.17	-1.55	11.73	167.90	< .001
Body Mass Index	15.69	1.90	20.42	2.37	197.24	< .001
EDE-Q – Total score	3.44	1.32	0.93	0.84	196.17	< .001
HS – Total score	9.59	5.53	11.82	3.00	9.56	.002
HS – Time since last meal	3.63	3.67	2.31	2.25	7.38	.007
HS – Subjective hunger (1–6)	2.22	1.63	4.17	1.40	64.59	< .001
HS – Subject's estimate of the amount of favorite food she would be able to eat (1–7)	2.04	1.32	3.86	0.95	97.71	< .001
HS – Time till next meal (hrs)	1.70	1.96	1.48	1.27	0.63	0.428
Frequency of eating high-fat food (0–100)	20.21	14.52	49.72	14.65	156.58	< .001
Frequency of eating low-fat food (0-100)	38.34	18.31	43.46	14.21	3.73	.055

Note. EDE-Q = Eating Disorder Examination – Questionnaire (Decaluwé, 1999); HS = Hunger Scales (Grand, 1968).

[8] Of 13 restricting AN-like patients information about education was not disclosed.

Stimulus selection

Stimulus selection was based on a study on the evaluation of high-fat and low-fat foods (Roefs et al., 2005a). Pictorial stimuli were used, as pictures may provide a more ecologically valid representation of food than words, and pictorial stimuli are generally assumed to be more strongly related to affective information than words (De Houwer & Hermans, 1994). Stimuli consisted of eight high-fat food pictures (pizza, croissant, chocolate, crisps, chips, ice-cream, brown spiced biscuit, and toast with ham and cheese), eight low-fat food pictures (strawberries, melon, grapes, popcorn, carrots, cherries, pineapple, and chicken). Eight neutral pictures were based on or derived from the International Affective Picture System (IAPS numbers: 7006, 7009, 7010, 7035; Lang, Bradley, & Cuthbert, 1996), and depicted cups, bowls, and baskets. IAPS pictures and other pictures were comparable in visual complexity and color.

Measures

A modified exogenous cueing task (ECT) was used to measure attentional bias for food cues (Koster et al., 2005). The ECT was programmed in E-prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002) and run on a Windows XP computer with a 22 inch CRT monitor (resolution set to 1024 by 768 pixels).

During each trial, two rectangles (9.8 cm high and 12.3 cm wide) were presented side by side on a grey-colored background, with a fixation cross presented in the middle of the screen. The middle of the rectangles was 9.2 cm (visual angle: 8.7º) from the fixation cross. Cues and targets were presented in the middle of the rectangles. Targets were grey squares (1.25 cm by 1.25 cm). Picture cues had the same size as the white rectangles. Responses were made by pressing one of two keys, labeled *left* and *right*, on a response box.

Each trial started with a 500 ms presentation of the fixation cross and the two white rectangles. Next, a picture cue appeared during 300 ms, 500 ms, or 1000 ms. The duration of the presentation of the picture cue was balanced over participants, a third of the participants received the 300 ms, a third the 500 ms, and a third the 1000 ms presentation duration. We preferred a between-subjects design to avoid carry-over effects and to limit the required effort for the patients. The target was presented 50 ms after cue offset and disappeared after a response was made. The following trial started immediately after the response.

The exogenous cueing task consisted of a practice block of twelve trials, followed by two test blocks of 96 trials. Each picture was presented four times to the participant (twice as valid trials: left cue – left target and right cue - right target; and twice as invalid trials: left cue – right target and right cue – left target). The trials were presented in a new random order to each participant.

Procedure

The experiment took place in the morning or afternoon and was part of a larger assessment procedure[9], so participants did not have a meal just before or immediately after the experiment. First, participants conducted the modified ECT. The participants were seated at 60 cm viewing distance from the computer screen to perform the task. Participants were asked to respond as quickly and accurately as possible to the location of the target by pressing the corresponding key on the response box.

Furthermore, participants filled out two questionnaires. The child version of the Eating Disorder Examination - Questionnaire (EDE-Q; Fairburn & Beglin, 1994; ChEDE-Q; Decaluwé, 1999) was administered, to allow for a comparison of eating disorder pathology between restricting AN-like patients and healthy controls. The EDE-Q is the questionnaire version of the Eating Disorder Examination and consists of four subscales (0 – 6 points): restraint, eating concern, weight concern, and shape concern. The total EDE-Q score provides a global measure of the severity of eating disorder pathology. Furthermore, the Hunger Scale (Grand, 1968) was administered to control for the influence of hunger. The Hunger Scale consists of four items: time since last eating (hrs), subjective hunger (1 – 6 points), the subject's estimate of the amount of favorite food she would be able to eat (1 - 7), and the time

[9] This study is part of a larger project on cognitive-motivational mechanisms in disordered eating. Therefore, two Affective Simon Tasks were administered, but these results are presented in a separate paper (Veenstra & de Jong, 2011).

till next meal (hrs). High scores refer to hunger or deprivation from food. Finally, weight and height data were collected by measuring and weighing all participants.

Results

Group characteristics

In line with the selection criteria, restricting AN-like patients had a lower Body Mass Index (BMI) than healthy controls, $F(1, 160) = 197.24$, $p < .001$, $d = 2.20$, and higher percentages of underweight, $F(1, 160) = 167.90$, $p < .001$, $d = 2.03$ (see Table 5.1 for a more detailed description of and comparisons between the samples). Furthermore, EDE-Q scores confirmed that eating disorder pathology was more prominent in the group of restricting AN-like patients, $F(1, 152) = 196.17$, $p < .001$, $d = 2.27$.

AN-like patients reported a lower motivational state of hunger than the control group, $F(1, 151) = 9.56$, $p < .01$, $d = .50$. However, the total hunger score may be biased as consistent with their cognitions restricting AN-like patients generally report a relatively low state of hunger or to experience no hunger at all. Therefore, the most objective measure of deprivation is probably the time since participants' last eating. For the Hunger Scale item 'time since last eating' a trend was found, $F(1, 151) = 6.33$, $p < .05$, $d = .41$. Restricting AN-like patients tended to report a longer time since last eating. Furthermore, compared to healthy controls restricting AN-like patients reported lower frequencies with which they ate high-fat food, $F(1, 152) = 156.58$, $p < .001$, $d = 2.02$, and there was also a non-significant tendency of lower frequencies of eating low-fat food, $F(1, 152) = 3.73$, $p = .06$, $d = .31$.

Exogenous Cueing Task

Trials of the ECT with errors (1.8%) and trials with reaction times below 150 ms and above 2000 ms (0.7%) were excluded from analyses. Patients and control group participants did not differ with respect to their number of errors, $t(157) = 1.49$, $p > .1$, $d = .24$.

Data were analyzed using a 3 (cue type: high-fat food, low-fat food, or neutral pictures) x 2 (cue validity: invalid or valid) x 2 (group: control group or restricting AN-like patients) x 3 (presentation duration: 300 ms, 500 ms, or 1000 ms) mixed models analysis of variance with the first two factors being within-subjects factors. If the relevant higher order effects were significant, the effects were analyzed by calculating cue validity effects, and attentional engagement as well as attentional disengagement scores (e.g., Koster et al., 2005; Veenstra et al., 2010). Cue validity effects and the modulation of attentional engagement and disengagement by food cues were calculated as follows:

Cue validity effect = RT invalid cue – RT valid cue

Attentional engagement = RT valid neutral cue – RT valid food cue

Attentional disengagement = RT invalid food cue – RT invalid neutral cue

A cue validity effect is called 'normal' when it is a positive score, which means that the attention is directed towards the valid cue compared to the invalid cue (which is expressed in lower RTs for valid than for invalid trials). Positive scores on attentional engagement are indicative of directing attention towards the food cues compared to the neutral cues. Positive scores on attentional disengagement are indicative of a difficulty to disengage from food cues compared to neutral cues.

All effects are reported as significant at $p < 0.05$. Effect-sizes are also reported using partial eta-squared ($\eta_p 2$; small: 0.01, medium: 0.06, and large effect: 0.14 (Cohen, 1977)) or Cohen's d (small: 0.20, medium: 0.50, and large effect: 0.80 (Cohen, 1992)).

Overall analysis. Most importantly, a significant presentation duration x validity x cue type interaction effect was found, $F(3.8, 298)$[10] = 2.77, $p < .05$, $\eta_p^2 = .04$. The differential allocation of attention to food varied as a function of presentation time. This pattern was similar for both groups, as is apparent from the non-significant four-way interaction, $F(3.8, 298) = .37$, $p > .1$, $\eta_p^2 = .01$. To interpret this three-way interaction effect, for each presentation duration we first examined whether the cue validity x cue type interaction reached significance. Then, we calculated the cue validity effects, attentional engagement scores and the attentional disengagement scores. See Table 5.2 for an overview of the results.

Other overall effects. The overall analysis also showed several other effects that are not directly relevant for the present hypotheses. There was a main effect of validity, $F(1, 158) = 60.64$, $p < .001$, $\eta_p^2 = .28$, and an interaction of presentation

[10] Due to violation of the assumption of sphericity, Greenhouse-Geisser correction was applied.

duration x validity, $F(2, 158) = 4.70$, $p < .05$, $\eta_p^2 = .06$. Furthermore, the significant three-way interaction qualified a main effect of cue type, $F(2, 316) = 9.50$, $p < .001$, $\eta_p^2 = .06$, and an interaction effect of cue type x validity, $F(1.9, 298) = 3.84$, $p < .05$, $\eta_p^2 = .02$ (all other F values < 1.).

Table 5.2: Response latencies as a function of group, cue type and cue validity.

	High-fat food		Low-fat food		Neutral pictures	
	Invalid	Valid	Invalid	Valid	Invalid	Valid
300 ms condition						
Control group ($n = 26$)	342 (60)	327 (46)	341 (60)	326 (51)	335 (56)	323 (51)
AN-like patients ($n = 26$)	368 (94)	351 (97)	362 (87)	344 (93)	361 (95)	349 (92)
500 ms condition						
Control group ($n = 24$)	320 (43)	326 (48)	323 (50)	312 (37)	322 (41)	312 (33)
AN-like patients ($n = 30$)	341 (63)	343 (52)	340 (65)	329 (56)	343 (58)	330 (54)
1000 ms condition						
Control group ($n = 26$)	333 (58)	320 (51)	333 (51)	313 (55)	332 (51)	317 (54)
AN-like patients ($n = 32$)	329 (56)	311 (64)	329 (60)	308 (62)	330 (52)	305 (62)

Note. Mean response latencies (in ms), with *SD* in parentheses.

300 ms condition. In the 300 ms condition, a normal cue validity effect was found, $F(1, 50) = 30.32$, $p < .001$, $\eta_p^2 = .38$, which indicates that participants were faster on valid trials compared to invalid trials. However, food did not differentially affect attentional allocation at a cue presentation of 300 ms, $F(2, 100) = .53$, $p > .1$, $\eta_p^2 = .01$.

500 ms condition. Food did affect attentional allocation in the 500 ms condition, as is apparent from the cue validity x cue type interaction, $F(1.7, 90)$[10] = 6.5, $p < .01$, $\eta_p^2 = .11$. This interaction qualified a main effect of cue type, $F(2, 104) = 5.18$, $p < .01$, $\eta_p^2 = .09$. No differences were found between restricting AN-like patients and healthy controls, as was apparent from the non-significant three-way interaction, $F(1.7, 90) = .11$, $p > .1$, $\eta_p^2 < .01$. Low-fat food and neutral pictures showed normal cue validity effects, $t(62) = 2.83$, $p < .01$, $d = .36$ and $t(62) = 3.11$, $p < .01$, $d = .39$, respectively, whereas high-fat food showed no significant cue validity effect, $t(62) = .10$, $p > .1$, $d = .01$. Participants tended to direct attention away from high-fat food. The cue validity effects of high-fat food differed from the cue validity effects of low-fat food, $F(1, 52) = 7.50$, $p < .01$, $\eta_p^2 = .13$, and neutral pictures, $F(1, 52) = 8.72$, $p < .01$, $\eta_p^2 = .14$. Cue validity effects of low-fat food and neutral pictures were generally the same, $F(1, 52) = .06$, $p > .1$, $\eta_p^2 < .01$.

See Figure 5.2 for attentional engagement and disengagement scores. Participants showed negative attentional engagement scores for high-fat food trials that were significantly different from zero, $M = -11.0$, $t(62) = 3.34$, $p < .01$, $d = .42$, indicating that there was less attentional engagement with high-fat food cues compared to neutral cues. There was also less attentional engagement with high-fat food than with low-fat food cues, $t(62) = 3.17$, $p < .01$, $d = .40$, whereas engagement scores for low-fat food trials did not differ from zero, $M = 0.3$ ms, $t(62) = 0.11$, $p > .1$, $d = .01$.

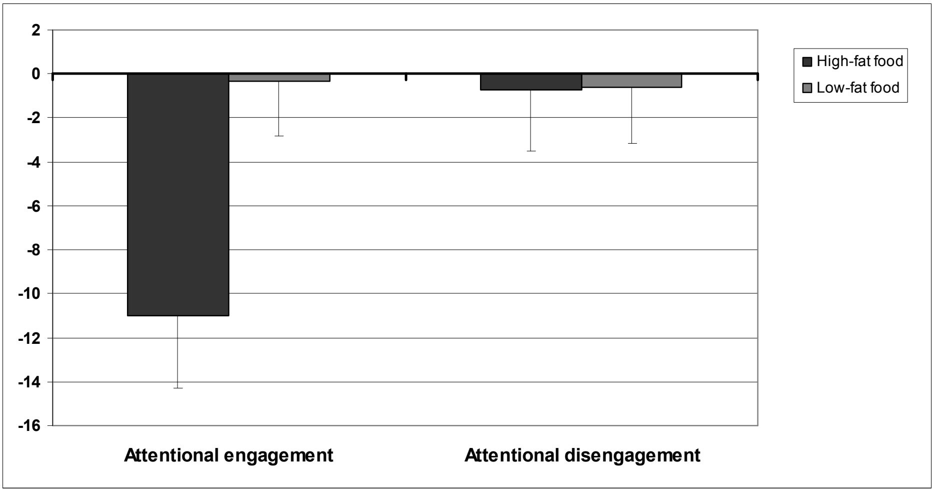

Figure 5.2: Attentional engagement and disengagement scores of high-fat and low-fat food in the 500 ms condition.

Disengagement scores for high-fat food and low-fat food trials did not significantly differ from zero, $t(62) = 0.25$, $p > .1$, $d = .03$ and $t(62) = 0.25$, $p > .1$, $d = .03$, respectively. Thus, no evidence was found for facilitated disengagement from food.

1000 ms condition. Similarly to the 300 ms condition, only a normal cue validity effect was found, $F(1, 50) = 50.37$, $p < .001$, $\eta_p 2 = .47$. Again, food did not affect attentional allocation, $F(2, 100) = 1.34$, $p > .1$, $\eta_p 2 = .02$.

Post-hoc correlational analysis. As food did affect attentional processes in the 500 ms condition, we further explored the relationship between dysfunctional eating behavior and attentional bias for food. Since the control group (logically) did not show a meaningful variation in eating pathology this correlational analysis was restricted to the restricting AN-like group. We computed Pearson's *p-m* correlations between attentional engagement scores of attentional bias for food on the one hand, and indices of disordered eating behavior (EDE-Q subscales) on the other hand. See Table 5.3 for an overview of the correlations.

Table 5.3: Correlations between indices of attentional bias for food and indices of disordered eating behavior in the group of restricting AN-like patients in the 500 ms condition.

	Attentional engagement	
	High-Fat Food	Low-Fat Food
EDE-Q – Restraint	0.00	0.39*
EDE-Q – Eating Concern	-0.21	0.05
EDE-Q – Weight Concern	-0.06	0.38*
EDE-Q – Shape Concern	0.04	0.31
EDE-Q – Total score	-0.05	0.33

Note. EDE-Q = Eating Disorder Examination – Questionnaire (Decaluwé, 1999)
*$p < .05$

Correlational analysis showed a positive correlation between the subscales EDE-Q Restraint and EDE-Q Weight Concern on the one hand, and attentional engagement with low-fat food on the other hand. (The same pattern was evident for EDE-Q Shape Concern). Thus restricting AN-patients with relatively high scores on indices of disturbed eating behavior showed enhanced engagement with low-fat food. It should be acknowledged, however, that if we would have applied Bonferroni correction for testing multiple correlations, none of the correlations would have remained significant.

Discussion

The present study examined attentional bias for high-fat and low-fat food in restricting AN-like patients and healthy controls. The main results can be summarized as follows: when pictures were presented for a relatively short duration (500 ms) (i) both restricting AN-like patients and healthy controls showed initial attentional avoidance of high-fat food, as indexed by a negative cue validity effect. (ii) Both groups also showed impaired attentional engagement with high-fat food compared to low-fat food and neutral stimuli, whereas (iii) no evidence was found for facilitated disengagement from high-fat food. (iv) Post-hoc correlational analysis revealed that severity of eating pathology within the group of restricting AN patients was related with stronger attentional engagement with low-fat food. (v) No biased attentional patterns were found when food pictures were presented for 300 ms or 1000 ms.

Whereas other studies investigated attentional bias for food in groups of different eating disorders, the present study is the first that examined attentional bias for food specifically in restricting AN-like patients. Restricting AN-like patients as well as healthy controls showed a pattern of attentional avoidance for high-fat food during relatively short presentation duration as indexed by the cue-validity effects. Both groups also demonstrated slower attentional engagement with high-fat food than with low-fat food and neutral pictures. This pattern of findings is consistent with the eating behavior of restricting AN-like patients [as they clearly avoid eating high-fat foods]. However, healthy controls showed the same attentional avoidance of high-fat food as was found in restricting AN-like patients. Thus, attentional avoidance of high-fat food appeared not specific for restricting AN-like patients, which suggests that these findings can be best considered as reflecting a general tendency to avoid high-fat food.

The present findings seem inconsistent with a recent brain imaging study that demonstrated that high-fat food led to increased activation of brain areas that relate to reward processing in healthy individuals (Frank et al., 2010). Furthermore, other brain imaging studies showed down regulation of cerebral areas in eating disordered patients and not so much in healthy controls, that point to a reduced attentional processing in eating disordered patients compared to healthy individuals (Giel et al., 2011). However, the differences in results might well be attributed to methodological differences, as in brain imaging studies participants were instructed to watch (to the content of) food pictures to elicit food-related information processing. So, participants had to process the content of the picture, whereas in the present ECT food was presented as a task-irrelevant feature, which could have resulted in differential effects on attention for food.

The present results are consistent with previous research examining attentional bias using the ECT in overeaters (Veenstra et al., 2010), which also showed a general tendency of avoidance of high-fat food in both unrestrained and restrained eaters. Attentional avoidance of high-fat food may be related to decreased awareness of high-fat food in the individual's environment, which may be a functional process in regulating one's weight. Attentional avoidance may help an individual to ignore the presence of high-fat food that otherwise may have led to the actual consumption of these foods. Perhaps then attentional avoidance of high-fat food reflects a usually functional strategy helping people to restrict their caloric intake that becomes counterproductive in underweighted people as it will logically help AN-like patients to persist in restricting their caloric intake.

Studies in the context of addiction assume that there is a reciprocal relationship between attentional bias and craving (Franken, 2003). In line with this, addiction studies demonstrated that higher craving led to stronger attentional bias to drug-related cues (e.g., Field, Mogg, & Bradley, 2005). So, it could be that differences in attentional processes may be potentiated by context-dependent factors that increase levels of craving. For example, the negative reinforcement model predicts that negative affect could increase attentional bias for food, which is supported by a recent study that showed negative mood induction increased selective attention to food in overeaters (Hepworth et al., 2010). So possibly, differences between diagnoses can be found when the context is potentiated (e.g., by negative mood). Conceivably, similar processes may be active in restricting AN-like patients and attentional avoidance could be potentiated by craving for food in restricting AN-like patients. However, it could also be that restricting AN-like patients are not so easily disturbed by seductive characteristics of food, and they could be relatively insensitive to these context cues thereby preventing the development of craving. Future research could test this issue by investigating whether manipulation of craving would be possible in restricting AN-like patients, and whether enhanced craving would lead to stronger attentional avoidance from high-fat food in restricting AN-like patients. This is supported by brain imaging studies that showed that higher craving would lead to enhanced attentional processing in healthy subjects and not so much in AN patients (e.g., Santel, Baving, Krauel, Münte, & Rotte, 2006).

Although the main analyses did not reveal a disorder-specific component of attentional bias for food, post-hoc analyses showed that within the group of restricting AN-patients relatively high scores on eating pathology were associated with a stronger attentional engagement with low-fat food. So, consistent with their dieting rules, AN-patients with relatively high concerns about shape and a strong urge to restrict their food intake more easily engaged their attention with low-fat food, which may help them to reach their goal of restricting their caloric intake. However, the present correlational results should be interpreted with care and it remains to be established whether this apparent disorder-related component in attentional bias for (low-fat) food in restricting AN represents a robust phenomenon.

Interestingly, previous studies using attentional bias tasks that considered all different eating disorder diagnoses did find a selective attentional biases for food/negative eating (Shafran et al., 2007; Smeets et al., 2008; Shafran et al., 2008; see also: Brooks et al., 2011). No such result was found in the present study. Possibly, the use of the ECT could account for these differences. However, this is not likely considering the similarity of the visual probe task and the exogenous cueing task (i.e., only difference is that in the visual probe task the participant is presented with two stimuli (neutral and food) and in the ECT the participant is presented with one stimulus and nothing on the other side). More likely, a difference in diagnostic groups could account for these differences in results. Consistent with the transdiagnostic theory (Fairburn, 2008), earlier studies on attentional bias for food considered different eating disorder diagnoses as different expressions of the same pathology and collapsed data of different diagnoses (or did not have enough power to distinguish between diagnoses). However, like (other) eating disorder features, attentional bias for food possibly also changes during transitions between diagnoses. To underline this suggestion, a study on attentional bias for body shape found distinct patterns for diagnoses of BN and AN (Blechert, Ansorge, & Tuschen-Caffier, 2010). Further research using the ECT in BN could solve this issue and could show enhanced engagement for high-fat food in longer presentation times.

Studies on attentional bias in anxiety have repeatedly shown a pattern of early vigilance to the object of threat, followed by a pattern of attentional avoidance; a so-called 'vigilance-avoidance pattern' (e.g., Mogg et al., 2004). Possibly, a similar vigilance-avoidance pattern also applies to (some) eating disorders. Then, the attentional avoidance could be a secondary cognitive strategy followed on an early vigilance for high-fat food. However, no evidence was found for attentional bias for food when stimuli were presented for 300 ms. Food did not influence attentional allocation at this point in time. However, more fine grained approaches using multiple short time intervals (e.g., 100, 150, 200 ms) are required to allow for more definite conclusions in this respect. The time point of 300 ms is still arbitrary and it would be interesting to see whether other early time points would show attentional bias for food. It would also be interesting to see how attention for high-fat food develops over time, for example by measuring eye movements (e.g., Jansen, Nederkoorn, & Mulkens, 2005).

Finally, it could also be that attentional bias for food does not play a role in AN, and differences between diagnoses may primarily appear after the initial processing of the presence of food. In AN, processing of food items may fail to elicit motivational orientation towards food. In line with this hypothesis, previous research indicated that restricting AN-like patients show less automatic motivational orientation towards food than healthy controls (Veenstra & de Jong, 2011).

A potential limitation of the study is the representability of the low-fat food items. Most stimuli were fruits, which might have influenced the results as fruits typically contain more sugar than low-fat food items such as vegetables. A more representative selection of low-fat food could for example have resulted in even stronger attentional engagement with low-fat food in restricting AN-like patients. Another potential limitation is that the healthy control group offers a sub-optimal comparison, because they were screened after they were tested. Screening the participants before they were tested could have generated a more optimal control group, which could have resulted in group differences on attentional bias. However, this seems not likely as despite they were screened after selection, the effect sizes of the differences in eating pathology and underweight were large (Cohen's *d*: 2.26 and 2.02).

Furthermore, in the present study there were several subgroups of restrictive eating disorders. Possibly, selecting a group of pure restricting AN patients would have resulted in a different attentional pattern between groups. The AN-like sample was, however, too small to reliably distinguish between subgroups. Future research could be improved by purely selecting restricting AN patients. In addition, it should be acknowledged that it cannot be ruled out that the attentional avoidance of high-fat food was (partly) due to particular differences between the food and neutral pictures (e.g., visual complexity or color). However, this is not likely as there were no differences between attentional processing of neutral and *low-fat* food stimuli.

Furthermore, restricting AN-like patients reported a longer time since last eating than the group of healthy controls, which could have affected their attentional deployment for food. However, it should be considered that a longer time since last eating could be a specific characteristic of restricting AN-like patients, which make it difficult to objectively assess hunger in restricting AN-like patients. Furthermore, if restricting AN-like patients had a stronger motivational state of hunger than the healthy controls, it would be expected that they showed stronger attentional engagement with food and/or a difficulty to disengage from food. However, just like the healthy controls they showed a pattern of attentional avoidance of high-fat food.

Finally, the generalizability of the present study is limited as the present study examined attentional bias in adolescents and not in adults with anorexia nervosa. For example, adolescents with anorexia nervosa probably demonstrate shorter durations of their illnesses than adults with anorexia nervosa which may influence their attentional avoidance from food. It would therefore be interesting to replicate this study in a group of restricting AN-like adults.

In conclusion, the present study provided no evidence that AN patients show enhanced attentional avoidance from (high-fat) food. The present results rather add to previous findings suggesting that people are generally characterized by attentional avoidance from high-fat food. This common attentional avoidance of high-fat food may be considered as a functional mechanism that may contribute to the restriction of caloric intake, which, however, becomes counterproductive in underweighted people. For future research, it would be interesting to see whether people who have difficulty to control their food intake (e.g., BN patients or obese individuals) do show enhanced engagement of and/or difficulty to disengage from high-fat food.

Chapter 6

General discussion

Introduction

Whereas overeaters struggle to manage their food intake, AN patients seem to have an unique ability to restrict their eating pattern. The central question of this thesis was therefore to explain why overeaters often fail to maintain a healthy eating pattern and why AN patients are so successful in the management of their food intake. The present thesis set out to explore cognitive-motivational mechanisms in the context of food-related material. More specifically, the potential role of relatively automatic processes of motivational orientation, liking associations and attentional bias in a group of restrained eaters and a group of restricting AN-like patients were investigated. As restrained eaters were tested as a model for overeaters, they will be called overeaters from here. The indirect measures of motivational orientation and liking associations were complemented with direct measures of subjective craving and the liking of food.

In this chapter, a summary of results of the four empirical studies will be presented (see also Figure 6.1 for a summary of findings). Results of the empirical studies will be integrated and discussed in the context of relevant models of cognitive-motivational mechanisms in eating disorders. Limitations, implications, and directions for future research will be discussed.

Empirical findings

Automatic motivational orientation towards food

Findings and integration in the literature. Chapter 2 and 3 (partly) focused on the potential role of automatic motivational orientation towards food in overeaters (Chapter 2) and restricting AN-like patients (Chapter 3), respectively. With the neurocognitive model of food reward (Berridge, 1996; Berridge, 2007) as their starting point, the studies presented in these chapters tested the hypothesis that automatic motivational orientation towards food (automatic tendency to approach food) might be sensitized in overeaters and desensitized in restricting AN-like patients. Differences in the sensitization of this motivational process of food reward could help explain why overeaters fail, and restricting AN-like patients succeed in the management of their food intake.

Interestingly, the empirical studies testing overeaters and restricting AN-like patients did support the hypothesis that motivational processes would be (de)sensitized in dysfunctional eating. Thus, overeaters showed enhanced automatic motivational orientation towards food, whereas in the group of restricting AN-like patients no automatic motivational orientation towards food was found (see first column of Figure 6.1). Whereas the automatic motivational orientation towards food seemed to be sensitized in overeaters, automatic motivational orientation towards food seemed to be desensitized in restricting AN-like patients. A stronger automatic tendency to approach food logically complicates the attempts of overeaters to restrict their food intake, whereas the absence of such an automatic approach tendency might help restricting AN-like patients to adhere to a deliberately restricted eating pattern. These results are consistent with the neurocognitive model of food reward, that suggests that motivational aspects of food (e.g., craving, appetite or the predisposition to eat) may play an important role in the dysregulation of food intake (Berridge, 1996; Berridge, 2007). The absence of automatic motivational orientation towards food in AN-like patients is also in line with the positive incentive theory which suggests that there could be a loss of the motivational saliency of food in AN. Additionally, these conclusions are supported by the correlational finding that relatively strong eating pathology and underweight was related to relatively weak automatic motivational orientation towards food.

In a previous study in overeaters stronger approach tendencies towards food were found in overeaters compared to normal eaters (Brignell et al., 2009). In this study participants were instructed to approach or to avoid pictures on the basis of food content (i.e., food-related or food-unrelated). Overeaters were relatively fast when the required response was to approach food pictures and relatively slow when the required response was to avoid food pictures. However, using the object of interest (i.e., food content) as task-relevant feature renders the task sensitive to strategic influences. The present study used food content as a task-irrelevant feature instead of a task-relevant feature, which provides additional evidence for the automatic (unintentional) nature of enhanced motivational orientation towards food in overeaters. Yet, the present findings seem to be inconsistent with another study which showed a pattern of stronger avoidance of food in a group of dieters compared to a group of non-dieters (Fishbach & Shah, 2006). However, differences in these previous findings could well be the result of differences in methodological aspects (i.e., verbal rather than pictorial stimuli, fitness rather than neutral stimuli as contrast category for food, and stimulus content as task-relevant feature). A contrast category of fitness words (e.g., slim, shape) as was used in this previous research might well have activated health concerns in participants and therefore avoidance responses in dieters.

Until now, only one study on automatic motivational orientation also included AN patients. In apparent contrast with our findings, this previous study found no differences in approach tendencies towards food between eating disorder patients and a non-clinical sample (Seibt et al., 2007). However, the relatively small eating disorder sample in this earlier study comprised of both BN patients (n = 7) and AN patients (n = 13), and thus of unsuccessful and successful dieters, which renders these results difficult to interpret in the context of the successful regulation of food intake.

Explicit motivational strategies might also contribute to the development and maintenance of dysfunctional eating. As explicit proxies of motivational orientation, self-reports of craving were investigated, and showed that self-reported craving could also help explain dysfunctional eating (see fourth column of Figure 6.1). The first study demonstrated different patterns of craving for high-fat and low-fat food in overeaters and the control group. Whereas overeaters showed no differences between craving scores for high-fat and low-fat food, control group participants reported lower craving scores for high-fat food compared to low-fat food. Thus in overeaters, a combination of stronger automatic motivational orientation and stronger craving for high-fat food might jointly contribute to a dysfunctional eating pattern. Additionally, the second study showed that restricting AN-like patients reported overall lower craving scores than healthy controls, and showed an opposite pattern of craving for high-fat and low-fat food as well. Whereas healthy controls reported stronger craving for high-fat food compared to low-fat food, restricting AN-like patients reported stronger craving for low-fat food compared to high-fat food, which is consistent with earlier research on food cravings (Moreno, Warren, Rodríguez, Fernández, & Cepeda-Benito, 2009). These explicit processes of

	Indirect measures						Direct measures			
	Motivational orientation		Liking associations		Attentional Bias (500 ms)		Explicit craving		Explicit liking	
	High-fat food	Low-fat food	High-fat food	Low-fat food	High-fat food	Low-fat food	High-fat food	Low-fat food	High-fat food	Low-fat food
Overeaters (restrained eaters) $n = 28$	Relatively strong approach tendencies		Relatively strong liking associations	Relatively weak liking associations	Relatively strong avoidance in unsuccessful dieters		Self-reported craving was similar for both food types **60***		Self-reported liking was similar for both groups and both food types	
Control group (unrestrained eaters) $n = 27$	No significant approach tendencies				Initial avoidance	No avoidance or selective attention	Relatively weak self-reported craving **54**	Relatively strong self-reported craving **61**		
Restricting AN-like patients $n = 89$	No motivational orientation towards food				No correlations found	Relatively strong attentional engagement	Relatively weak self-reported craving **24**	Relatively strong self-reported craving **32**		
Healthy controls $n = 76$	Enhanced motivational orientation towards food				Initial avoidance	No avoidance or selective attention	Relatively strong self-reported craving **57**	Relatively weak self-reported craving **50**		

* Numbers in the explicit craving section refer to Visual Analogue Scale scores (0 - 100)

restricting AN-like patients might help them manage their food intake. Thus, both explicit and implicit motivational processes might cumulatively contribute to the development and maintenance of dysfunctional eating.

Limitations. For the both control groups similar patterns of motivational orientation towards food would be expected. However, when comparing our studies on overeaters and restricting AN-like patients the results of both control groups seem not entirely consistent (see also Figure 6.1). The control group in the first study and healthy control participants in the second study showed distinct patterns of motivational orientation towards food. Whereas the control group in the first study showed no motivational orientation towards food, healthy control participants in the second study did show motivational orientation towards food. However, this apparent dissimilarity in automatic motivational orientation in control groups should be interpreted with care as these groups have several different characteristics. Both groups differ on age and cognitive development, as the control group participants in the first study were first year college students and the healthy control participants were secondary school pupils of different educational levels. Relatively high educational level and relatively high age might both have helped first year college students to suppress the influence of the attractive characteristics of food stimuli, which could logically lower their scores on automatic motivational orientation towards food. In addition, whereas the group of healthy controls was defined by an absence of eating pathology and healthy weight, the control group in the first study was only defined by a low tendency to restrict food intake, which makes results about this second group difficult to interpret. Furthermore, conclusions of the first control group are based on RT data, whereas conclusions of healthy control participants are based on error data, which are different operationalizations of automatic motivational orientation. Probably, different strategies with regard to response speed (RT data) and response accuracy (error data) might have resulted in distinct patterns of responses. These factors might have (individually or jointly) resulted in different AST-manikin performance. Therefore, in the future, present results should be replicated to arrive at more final conclusions regarding the automatic motivational orientation towards food in healthy subjects.

Automatic liking associations with food.

Findings and integration in the literature. Chapter 2 and 3 also focused on the potential role of liking associations with low-fat and high-fat food in overeaters (Chapter 2) and restricting AN-like patients (Chapter 3). Note that the incentive-sensitization theory suggests that (de)sensitization of motivational processes rather than affective processes is critical in dysfunctional eating behavior. However, there is ample evidence that positively valenced stimuli elicit more approach than negatively valenced stimuli (Chen & Bargh, 1999). Furthermore, previous studies in the context of food stimuli showed mixed results in this respect (Roefs et al., 2011). Therefore, these studies aimed to investigate whether automatic liking associations with food could also play a role in dysfunctional eating behavior.

The present findings did not support a potential role of liking associations with food in dysfunctional eating. In the first study (Chapter 2), no differences were found between overeaters and the control group. Food did nevertheless elicit (automatic) liking responses, and both overeaters and the control group demonstrated relatively strong liking of high-fat food and relatively weak liking of low-fat food. Stronger liking associations with high-fat food than with low-fat food seem to be a more general phenomenon that is not restricted to people who show dysfunctional eating. These findings are consistent with the incentive-sensitization theory which suggests that wanting food and not so much liking food is critical in dysfunctional eating (e.g., Berridge, 2009). However, previous studies that examined automatic affective associations with food mostly found negative affective associations with food (see for a review: Roefs et al., 2011), which will be discussed in the next paragraph.

Limitations and implications for future research. Although the data did not support a potential role of liking associations in dysfunctional eating, the use of a tasty-untasty dimension in the AST-voice key seemed to be a fruitful approach to uncover automatic liking associations. Until now, most studies used a positive-negative dimension as relevant response option in indirect tasks, which may have generated responses based on health concerns with food rather than on liking food (cf., Roefs et al., 2005b), and this might explain why thus far most research found negative rather than positive affective associations with food (Roefs et al., 2011). However, both response options (i.e., positive-negative and tasty-untasty) have never been directly compared, which would be necessary for more final conclusions in this respect. Future research could incorporate both response options and investigate whether differences in response options result in different patterns of affective associations with (high-fat) food. Furthermore, the predictive validity of both response options for eating behavior would be especially relevant, as both types of associations might be differentially involved in people's tendency to select/eat particular food items.

Unfortunately, the present AST-voice key data appeared to be ineffective as an index of automatic liking. The presentation of food pictures did not affect responses in restricting AN-like patients and healthy control participants. In the AST-voice key, participants had to respond with saying 'tasty' and 'untasty' on the basis of the shape of the picture (i.e., task-relevant feature: landscape or portrait format), and were presented with neutral and food pictures. Whereas this task revealed liking associations with food in participants in the first study, no differences in tasty-untasty responses were found between food and neutral pictures, thus no liking associations were found at all. The ineffectiveness of the task in the second study might be attributed to age as well as cognitive development of the participants. The second study comprised of secondary school pupils of different educational levels, whereas the first study comprised of first year college students. Probably, for the younger age group the task was relatively difficult, as they had to differentiate between portrait and landscape pictures that only differed 15% in length and width, which might have been too subtle for this sample. Probably, the task difficulty resulted in that all cognitive resources were needed to arrive at the proper response, which made the task insensitive for the interfering effect of the task-irrelevant feature (i.e., food content). So, the question whether automatic liking associations with food are involved in restricting AN-like patients remains to be answered. Future research using an easier task-relevant stimulus feature in adolescents or the same task in adult AN patients could help answer the question whether liking associations with food would be disturbed in restricting AN.

Attentional Bias.

Findings and integration in the literature. Chapter 3 and 4 concentrated on the potential role of attentional bias for food in dysfunctional eating. There are already many studies that investigated this research question (see for a review: Dobson & Dozois, 2004; Faunce, 2002; Johansson et al., 2005), and most of these previous studies found stronger attentional bias for food in dysfunctional eating, using Stroop and dot probe tasks. The present studies, however, used the ECT to measure attentional bias, which aims to measure different attentional components, namely vigilance, attentional engagement, and attentional disengagement, which may add to the present knowledge of the different components of attentional bias that may be differentially involved in dysfunctional eating. Furthermore, earlier research did not distinguish between diagnoses and collapsed data of all eating disorder diagnoses, while possibly, attentional bias for food could differ between BN and AN (e.g., stronger attentional bias for food and attentional avoidance, respectively).

The third column of Figure 6.1 depicts results of the empirical studies on attentional bias for food. Food pictures were presented for different presentation durations to allow for a more thorough investigation of attentional bias over time (i.e., 300 ms (only in AN study), 500 ms, 1000 ms, and 1500 ms). Food did only affect attention when pictures were presented for 500 ms. However, both overeaters and restricting AN-like patients did not differ from their respective control groups on attentional bias for food. Restricting AN-like patients, overeaters and both control groups displayed attentional avoidance of high-fat food (i.e., less attentional engagement with high-fat food). So, attentional avoidance of high-fat food appeared to be a more general attentional mechanism. This relatively automatic (unintentional) tendency to avoid attentional engagement of high-fat food stimuli seems entirely consistent with intentional strategies of people to regulate their food intake. Attentional avoidance of high-fat food might help an individual to decrease awareness of high-fat food in the environment, which would logically help to prevent food stimulus-induced craving, and may thus be a functional process in regulating one's weight.

Overall, the present findings on attentional bias for food are in line with previous research on attentional bias for food in dysfunctional eating. The absence of group differences in attentional bias for food between overeaters and the control group is consistent with previous research in overeaters and the control group using a 500 ms dot probe methodology (Boon et al., 2000). The study in restricting AN-like patients, however, is the first that considered attentional bias in this specific group. Previous dot probe studies in eating disorders collapsed data of different eating disorders (e.g., BN, AN, ED-NOS), and found selective attentional biases for food when food was presented for 1000 ms (Shafran et al., 2007; Shafran et al., 2008).

Whereas the main factorial analyses give the impression that there is no disorder-related component in attentional processes for food, post-hoc correlational analyses did reveal some disorder-related correlations. However, these correlational results should be interpreted with care and it remains to be established whether these apparent disorder-related components in attentional bias in overeaters and restricting AN-like patients represent robust phenomena. Within the group of restricting AN-like patients, relatively high eating pathology was related to relatively strong engagement with low-fat food. This relatively strong attentional engagement with low-fat food corresponds to the explicit strategy of restricting AN-like patients to choose low-fat food over high-fat food. The study on attentional bias in overeaters showed that relatively high levels of disinhibited eating (i.e., unsuccessful dieting or overeating) were related to relatively strong attentional avoidance of high-fat food. So, contrary to our expectations, overeaters showed relatively strong avoidance of high-fat food. This finding is consistent with earlier research that showed that overeaters who are easily triggered to eat by food-relevant stimuli (i.e., external eating as defined by Van Strien et al., 1986) also tended to direct attention away from food (Johansson et al., 2004). Although a pattern of attentional avoidance of food provides no indication that attentional bias for food plays an important role in the pathogenesis of disinhibited eating, repeated periods of prolonged deprivation may enhance the reward value of food (cf., Brown et al., 1998). Therefore it cannot be ruled out that in the long run, this attentional avoidance, which seems to be highly adaptive, could become counterproductive as it could hinder habituation and learning to cope with the seductive characteristics of high-fat food.

Limitations and implications for future research. Previous dot probe studies found attentional biases for food when food was presented for 1000 ms (Shafran et al., 2007; Shafran et al., 2008), whereas in the present study no such result was found when food was presented for 1000 ms. Possibly, the use of the ECT could account for these dissimilarities. However, this seems not very likely considering the similarity of the visual probe methodology and the ECT. More likely, this difference could be explained by differences in diagnostic groups. Consistent with the transdiagnostic theory (Fairburn, 2008), previous research considered different diagnoses as different expressions of the same pathology. However, it might well be that attentional bias for food, like other eating disorder symptoms, changes during transitions between diagnoses. To support this, a recent study showed differences in attentional bias for body shape between BN and AN (Blechert et al., 2010). AN patients showed an attentional bias for self-body images, whereas in BN patients a non-significant tendency for attentional bias for other-body images was found. However, it should be acknowledged that this study also demonstrated differences between AN patients and healthy controls, which was not the case in the present empirical findings. Anyhow, attentional bias for body shape and food may act in different ways, and, probably, AN patients do show attentional bias for body shape-related stimuli and not so much for food-related stimuli in order to avoid the generation of craving for food. Further research using the ECT in BN patients could clarify the apparent inconsistency of the present study with previous studies. If the apparent inconsistency is due to the specific group of restricting AN-like patients, future research with the ECT in BN patients would find stronger attentional engagement with high-fat food and/or a difficulty to disengage from high-fat food.

Furthermore, it should be acknowledged that when food pictures are presented for 500 ms, multiple shifts in attention are possible. Therefore, it could be that a stage of maintained attention is measured instead of early vigilance (e.g., Field & Cox, 2008), and it could not be ruled out that participants initially oriented their attention towards food. That would mean that attentional avoidance would be a secondary cognitive strategy. It could be that this presumed first cognitive strategy of the orientation of attention is disturbed in dysfunctional eating. For example, restricting AN-like patients could show early disengagement from food which could help them reduce the development of craving, and subsequently, restrict their food intake.

In the first study on overeaters, we used 500 ms as shortest presentation duration. Because of the hypothesis that group differences would be present in even shorter presentation durations, in the second study with restricting AN-like patients the 300 ms condition was introduced to search for more automatic attentional processes. However, food did not affect attentional processes on the 300 ms level as well. To arrive at more final conclusions in this respect it would be important to replicate these studies by adding an even shorter presentation duration (e.g., 100 or 150 ms). A recent visual probe task study that presented food pictures for 100 ms provided evidence for this hypothesis, and demonstrated stronger attentional bias for food-related cues in obese individuals compared to normal-weight individuals (Nijs et al., 2010). As investigation of time points is still arbitrary, future research should also consider to use eye movement methodology which allows a more precise analysis of individual attentional deployment over time (Jansen et al., 2005).

Another consideration for future research could be obtained from theories in addiction that assume that there is a reciprocal relationship between attentional bias and craving (Franken, 2003). So, possibly, attentional bias for food could be potentiated by craving for food in overeating. In line with this, studies in addiction demonstrated that manipulation of craving led to stronger attentional bias to drug-related cues (e.g., Field et al., 2005). Accordingly, the seemingly highly adaptive process to avoid further engagement with high-fat food could prevent the generation of craving for 'forbidden' food. However, when an individual encounters a context that activates craving (e.g., by seductive characteristics of food, like the smell or sight of food), that may reduce the attentional avoidance of food, and craving may change attentional avoidance for high-fat food into further attentional engagement with food. So, it could be that differences in attentional processes may be potentiated by context-dependent factors that increase levels of craving. Probably, for restricting AN-like patients the relatively strong attentional engagement with low-fat food may not be so easily disturbed by seductive characteristics of food, and they could be relatively insensitive to develop craving. Future research could test this issue by investigating whether manipulation of craving would lead to an attentional bias for food in disinhibited eaters and not so much in restricting AN-like patients.

Several studies already investigated factors that may enhance levels of craving and in turn attentional bias for food. One factor that may give rise to enhanced craving is the motivational state of hunger, which has been studied several times in healthy individuals (e.g., Mogg et al., 1998; Lavy & van den Hout, 1993), and provide evidence that hunger increases attentional bias for food. Few studies examined the influence of hunger in dysfunctional eating. For example, a visual probe study showed that obese/overweight individuals showed stronger attentional bias for food pictures (presented for 100 ms) then normal weight individuals, especially when they were food-deprived (Nijs et al., 2010). However, an eye-tracking study showed stronger attentional bias for food in normal weight individuals when they were food-deprived then when they were satiated, whereas obese individuals showed attentional bias for food irrespectively of their motivational state of hunger (Castellanos et al., 2009), which does not support that in dysfunctional eating attentional bias will be especially elicited when people are in a state of hunger.

Other factors could also increase levels of attentional bias. For instance, earlier research demonstrated stronger Stroop interference in obese children when food words were presented in blocked format than when they were presented in mixed format. This cumulative presentation of food seems to lead to a break-down of strategic control and stronger attentional bias (Braet & Crombez, 2003). Furthermore, food-related cues in the environment may also enhance levels of craving and attentional bias, as similar research in alcohol use showed that the presentation of alcohol-related cues before the Stroop task led to Stroop interference but only in heavy drinkers (Cox, Yeates, & Regan, 1999). In a similar vein, food cue exposure may lead to higher levels of craving and a break-down in attentional control. Furthermore, a recent study suggested that negative mood could also enhance levels of craving and demonstrated that negative mood was associated with stronger attentional bias for food. Furthermore, attentional bias for food was positively associated with overeating (Hepworth et al., 2010). So, future research could use several factors to elicit craving and see whether higher levels of craving may lead to stronger attentional engagement with food in overeaters, and whether these factors will result in probably even stronger attentional avoidance in restricting AN-like patients.

Conclusion. The present findings suggest a general tendency to direct attention away from high-fat food when food is presented for 500 ms. Present findings provide no support for the view that attentional bias for food is critically involved in dysfunctional eating and seem not very helpful to explain why overeaters fail and AN patients succeed in the regulation of their food intake. This attentional mechanism may be a functional process that helps people to adhere to a healthy eating pattern and avoid fattening foods. However, in certain circumstances this process may become counterproductive in overeaters and restricting AN-like patients (e.g., hunger, food cue exposure, negative mood). So, whereas no general disorder-related component in attentional bias could be found, future research could consider interaction of attentional bias for food with other processes.

Integration present findings

The present thesis focused on the role of three cognitive-motivational mechanisms (automatic motivational orientation, liking associations, and attentional bias) that could possibly be involved in the (un)successful regulation of people's caloric intake. Figure 1.4 of Chapter 1 depicted a heuristic model of how these processes could influence food intake. As a first step to test this model, the present thesis focused on these processes separately to see whether they individually might add to dysfunctional eating behavior. Figure 6.1 depicts the heuristic model after the processing of the results.

The empirical findings support the (separate) involvement of automatic motivational orientation towards food in dysfunctional eating, and are consistent with the hypothesis that high automatic motivational orientation towards food is involved in dysregulation of food intake and low automatic motivational orientation in the successful regulation of food intake. The involvement of motivational orientation in dysfunctional eating could provide interesting starting points for future research which will be discussed in the next paragraph. The empirical findings, however, provide no support for the alleged role of automatic liking associations with food in restrained eating. Nevertheless, liking associations with high-fat food were overall stronger than liking associations with low-fat food, which may be a general complicating factor in the management of a healthy eating pattern. Furthermore, the question whether liking associations with food would be disturbed in restricting AN-like patients remains to be answered. Furthermore, the empirical findings provided only little evidence for the hypothesized role of attentional bias for food in dysfunctional eating. As discussed before, possibly, attentional bias for food could be found when food is presented for a shorter duration, like 100 ms. Another fruitful approach would be to examine factors that may enhance attentional bias by means of higher levels of craving in overeaters. Possibly, restricting AN-like patients are relatively insensitive to develop craving or craving might result in stronger attentional avoidance, which both could be superior mechanisms to restrict their food intake.

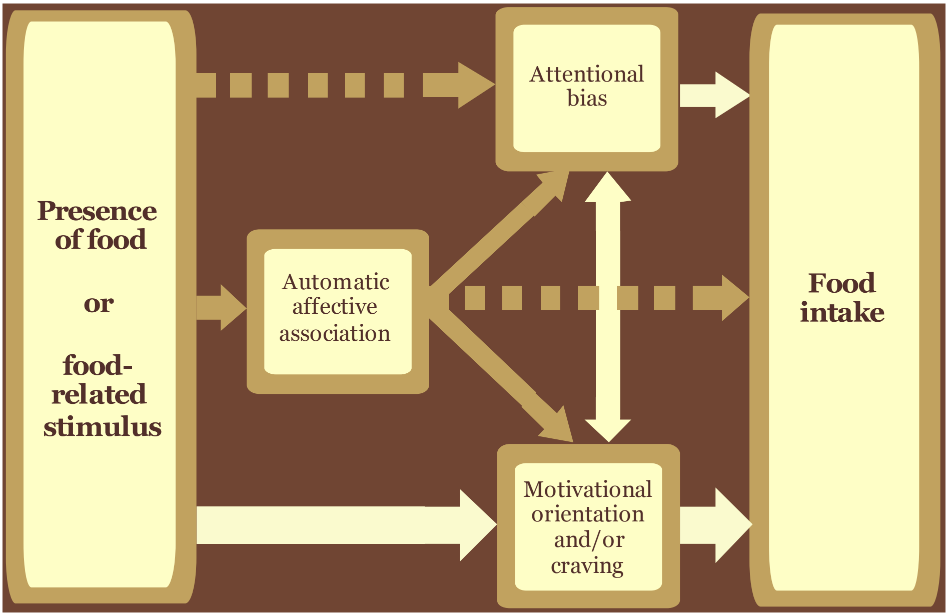

Figure 6.1: Heuristic model of cognitive-motivational mechanisms and their involvement in dysfunctional eating after integration of present findings. Light arrows represent relations that are supported by this thesis and seemed to be involved in dysfunctional eating and/or possibly offer fruitful leads for future research. The darker, interrupted arrows represent relations for which no or little support is found to suggest involvement of that process in dysfunctional eating.

General implications, limitations and future research

The empirical studies do support the incentive-sensitization theory, which suggests that motivational processes, and not so much liking, would play an important role in the dysregulation of food intake. The present findings suggest that automatic motivational orientation is involved in dysfunctional eating, whereas automatic liking associations with food seem not to play a role in overeating. Although the processes of wanting and liking seem to be theoretically connected to automatic motivational orientation and liking associations, it remains to be seen whether this 'operationalization' indeed reflects wanting and liking as indicated by Robinson and Berridge. So possibly, future research could incorporate both neurological and indirect psychological measures to see whether 'wanting' and automatic motivational orientation, 'liking' and liking associations indeed reflect the same constructs.

An important limitation of the present findings is the correlational nature of the studies. It cannot be decided whether differences in cognitive-motivational mechanisms influence a dysfunctional eating pattern, or that differences in these mechanisms are merely symptoms of dysfunctional eating patterns. So, the involvement of automatic motivational orientation towards food in dysfunctional eating might reflect a causal role, but the differences in automatic motivational orientation could also be just epiphenomena. One way to test the possible causal role of automatic motivational orientation is to train approach and avoidance tendencies for food in a healthy group to see whether higher automatic motivational orientation and/or an absence of automatic motivational orientation lead to more eating disorder-related concerns. Additionally, it would be clinically interesting whether retraining approach tendencies could also successfully modify automatic motivational orientation towards food in restricting AN-like patients. Accordingly, recent research in alcohol misuse demonstrated that successful training of avoidance tendencies for alcohol was associated with changes in actual drinking behavior, as they tended to drank less beer during the subsequent taste test (Wiers et al., 2010). Correspondingly, it would be interesting to see whether a modification of automatic approach tendencies towards food result in favorable changes in eating behavior of AN-like patients. So, successful training of automatic approach tendencies towards food could lead to larger food consumption in restricting AN-like patients. Another important question that remains to be answered is whether current treatments lead to change in automatic motivational orientation. Possibly, when restricting AN-like patients still show an absence of motivational orientation towards food following apparently successful treatment, this may set these girls at risk for a return of eating disorder symptoms. Then, retraining automatic motivational orientation towards food would be an especially relevant next step. Another interesting question would be to see whether motivational orientation towards food would also change during transitions between diagnoses of AN and BN. If so, it could be that a relatively sudden increase of motivational orientation towards food results in disinhibited eating patterns, which then could (partly) explain frequent transitions between diagnoses.

Another limitation of the present studies concerns generalizability of the selected groups. First, the purpose of the selection of restrained eaters as group of overeaters was to select a group of unsuccessful dieters, however, a group of restrained eaters could comprise of both successful and unsuccessful dieters, which may have compromised results of the present studies. Further research could be improved by only selecting unsuccessful dieters. Furthermore, the studies in restricting AN-like patients only examined adolescents and not adults with restricting anorexia nervosa. It could be that shorter durations of illnesses in adolescents with AN influence these cognitive-motivational mechanisms, as eating disorder characteristics are probably less fixed in adolescents compared to adults with longer illness durations. Thus, findings on motivational orientation towards food could be more pronounced in adults with restricting AN, and, possibly, group differences on attentional bias for food could be found in adult patients with restricting AN. Therefore, present studies should be replicated in adult AN patients.

Conclusion

The major implication of this thesis is that automatic motivational orientation towards food might help explain disinhibited eating patterns in overeaters and extremely restricted eating patterns in AN patients. Overeaters seemed to be characterized by a tendency to approach food, which might complicate the management of a healthy eating pattern. On the other hand, restricting AN-like patients do not have such a tendency to approach food, which might help explain why they are so successful to restrict their food intake.

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Samenvatting

Inleiding en achtergrond

Waarom zijn sommige mensen succesvol in het volgen van een gezond eetpatroon en waarom hebben sommige mensen juist moeite om een gezond eetpatroon te volgen? Deze vraag staat centraal in dit proefschrift.

Het Voedingscentrum verstrekt informatie over wat een gezond eetpatroon is en welke hoeveelheid voedsel passend is voor verschillende leeftijden en leefstijlen. Ze raden een totaal aan van 2000 kilocalorieën per dag voor vrouwen en 2500 kilocalorieën per dag voor mannen (Voedingscentrum, 2011). Ondanks dat er veel informatie beschikbaar is over passende en gezonde hoeveelheden voedsel, lijken veel mensen moeite te hebben om zich aan een gezond eetpatroon te houden en ontwikkelen overgewicht. Er is sprake van overgewicht vanaf een BMI van 25 of hoger (BMI = gewicht/lengte in m^2) en van obesitas vanaf een BMI van 30. In 2009 hadden 64% van de mannen en 54% van de vrouwen overgewicht, terwijl in 1981 slechts 41% van de mannen en 36% van de vrouwen overgewicht hadden (Swinkels, 2011).

Hoewel veel mensen moeite hebben om niet teveel te eten, is er ook een kleine groep mensen die extreem goed zijn in het volgen van een door henzelf opgelegd eetpatroon en ontwikkelen ondergewicht. Deze mensen lijden aan Anorexia Nervosa (AN) en kenmerken zich door een zeer beperkte voedselinname, die gedreven wordt door strenge en rigide eetregels (bv. een maximum van 600 kilocalorieën per dag). Ondanks hun ondergewicht (BMI < 17,5) hebben AN-patiënten een intense angst om in gewicht aan te komen en doen ze vaak aan excessieve lichaamsbeweging om gewicht te verliezen of niet aan te komen in gewicht (Fairburn, 2008). Hoewel AN niet zoveel voorkomt, heeft AN een slechte prognose en sterft 5 – 15% van de AN-patiënten uiteindelijk aan de gevolgen van de eetstoornis (Hoek, 2006; Huas et al., 2011).

Volgens de cognitieve gedragstheorie van eetstoornissen hechten eetstoornispatiënten overdreven veel waarde aan hun lichaamsvormen en gewicht bij het vormen van hun zelfbeeld (Williamson, White, York-Crowe, & Stewart, 2004). Voor een AN-patiënt kan dit bijvoorbeeld betekenen dat als ze een paar kilo aankomt, ze denkt dat de mensen om haar heen haar minder aardig zullen vinden. Een dergelijke gedachte of cognitieve structuur wordt ook wel een schema genoemd en in een schema worden begrippen als gewicht en voedsel gekoppeld aan betekenissen die te maken hebben met zelfcontrole of eigenwaarde (Vitousek & Hollon, 1990). Hierdoor kan voedsel- en gewichtsgerelateerde informatie in de omgeving (bv. chocola op de tafel; bikinimodel op een poster) invloed hebben op gedachten, stemming en gedrag. Verder kunnen deze schema's de perceptie van voedsel- en gewichtsgerelateerde informatie beïnvloeden. Aandachtsprocessen en motivationele mechanismen als de motivationele oriëntatie (naderen/vermijden van voedsel) en affectieve processen (lekker/vies vinden van voedsel) kunnen veranderen ten gunste van het schema. Dat zou dan bijvoorbeeld kunnen betekenen dat AN-patiënten onbewust vet voedsel minder lekker vinden omdat dit gunstig is voor hun zelfschema over voedsel. Als een AN-patiënt bijvoorbeeld een zelfschema heeft waarin vet voedsel gekoppeld is aan dik zijn en negatieve beoordeling door de omgeving, is een mechanisme waarbij je voedsel op onbewust niveau minder lekker vindt gunstig en helpend voor de instandhouding van het zelfschema en helpt het daarmee ook het disfunctionele eetgedrag in stand te houden. Dus door verandering in deze cognitief-motivationele mechanismen kunnen schema's juist weer bevestigd worden en leiden tot versterking van het disfunctionele eetgedrag.

Dit proefschrift was er op gericht om verschillende cognitief-motivationele mechanismen te onderzoeken met betrekking tot voedsel bij disfunctioneel eetgedrag. Bij motivatie lijken twee automatische processen van belang voor de bepaling van voedselinname, namelijk automatische motivationele oriëntatie (neiging om te naderen/vermijden) en automatische affectieve associaties (lekker/vies-associaties) (Strack & Deutsch, 2004; Deutsch & Strack, 2006). Verder is gekeken naar een mogelijke aandachtsvertekening ('aandachtsbias') voor voedsel die de voedselinname mogelijk zou vergemakkelijken (selectieve aandacht voor voedsel) of bemoeilijken (vermijding van de aandacht voor voedsel). Deze drie cognitief-motivationele mechanismen zijn onderzocht bij mensen die extreem succesvol zijn in het volgen van een eetpatroon, namelijk AN-patiënten van het beperkende type (en ook patiënten met een Eetstoornis NAO, die niet voldeden aan alle maar wel aan de meeste criteria van beperkende AN) en bij mensen die geneigd zijn te falen in hun lijnpogingen, 'restrained eaters'. Restrained eaters proberen hun voedselinname te beperken, maar falen hier vaak in en eten dan juist het voedsel waarvan ze vinden dat ze het niet zouden moeten eten. Deze groep van restrained eaters is onderzocht als model voor overeters en zullen worden vanaf hier overeters genoemd worden.

Automatische motivationele oriëntatie en affectieve 'lekker' associaties

Hoofdstuk 2 had tot doel om automatische motivationele oriëntatie voor voedsel en automatische associaties met voedsel in kaart te brengen bij overeters. Volgens de 'incentive-sensitization' theorie zouden vooral automatische motivationele processen en niet zozeer automatische affectieve processen verstoord zijn bij disfunctioneel eetgedrag (Berridge, 1996; Berridge, 2009). Er zijn echter ook aanwijzingen dat automatische affectieve associaties met voedsel ook een rol zouden kunnen spelen bij disfunctioneel eetgedrag. Zo heeft een reeks studies laten zien dat positieve stimuli eerder de neiging tot naderen oproepen dan negatieve stimuli (bv., Chen & Bargh, 1999). Dus in het geval voedsel automatisch positieve affectieve associaties oproepen, is het goed denkbaar dat dit resulteert in een relatief sterke neiging voedsel te gaan naderen.

Wat betreft de automatische affectieve associaties met voedsel lieten zowel overeters als de controlegroep zien dat ze sterkere automatische 'lekker'-associaties hadden met vet voedsel dan met mager voedsel. Wanneer beide groepen echter expliciet gevraagd werd hoe lekker ze verschillende voedselproducten vonden, rapporteerden ze geen verschillen tussen vet en mager voedsel. Deze resultaten suggereren dat mensen over het algemeen vet voedsel onbewust lekkerder vinden dan magere voedselproducten. Maar omdat deze onbewuste voorkeur niet verschilde tussen overeters en de controlegroep lijken automatische affectieve associaties niet betrokken bij disfunctioneel eetgedrag. Relatief sterke 'lekker'-associaties met vet voedsel lijken meer een algemeen verschijnsel wat mensen het mogelijk moeilijk kan maken om vet voedsel te weerstaan.

Overeters lieten echter wel een sterkere automatische neiging zien om voedsel te naderen dan de controlegroep. De bevinding dat overeters een sterkere motivationele oriëntatie naar voedsel vertonen is consistent met de 'incentive-sensitization' theorie (Berridge, 2009), aangezien de automatische motivationele oriëntatie en niet de automatische affectieve processen verstoord lijken te zijn bij overeters. Deze sterkere automatische motivationele oriëntatie voor voedsel kan de problemen die overeters ervaren met hun lijnpogingen helpen verklaren. Hoewel deze groep overeters probeert om de voedselinname te beperken kunnen deze pogingen door een sterkere automatische neiging om voedsel te naderen worden verhinderd.

Hoofdstuk 3 liet zien dat de automatische motivationele oriëntatie voor voedsel ook betrokken leek te zijn bij het disfunctionele eetgedrag van beperkende AN-patiënten. Waar overeters zich kenmerkten door een sterkere motivationele oriëntatie voor voedsel, lieten beperkende AN-patiënten juist zien dat ze op automatisch niveau minder sterk de neiging hadden voedsel te naderen dan gezonde mensen. Op zelfrapportagematen lieten beperkende AN-patiënten een soortgelijk patroon zien. Beperkende AN-patiënten rapporteerden minder 'craving' (zin in eten/drang om te eten op dit moment) voor voedsel in vergelijking met de gezonde controlegroep. Zowel de verminderde automatische motivationele oriëntatie voor voedsel als de meer expliciete strategie om voedsel te vermijden kunnen helpen verklaren waarom beperkende AN-patiënten zo succesvol zijn in het volharden in hun restrictieve eetpatroon.

De bevindingen met betrekking tot de automatische motivationele oriëntatie bieden in de toekomst wellicht aanknopingspunten voor behandeling. Er zijn recente aanwijzingen dat 'retraining' van automatische motivationele oriëntatie voor alcohol zelfs effecten kan hebben op daadwerkelijk drinkgedrag (Wiers, Rinck, Kordts, Houben, & Strack, 2010). Naar analogie is het denkbaar dat automatische motivationele oriëntatie voor voedsel in de toekomst getraind zou kunnen worden bij AN-patiënten, wat dan mogelijk zou kunnen leiden tot verbeteringen in eetgedrag. Bij overeters zou de automatische motivationele oriëntatie voor voedsel verminderd kunnen worden, wat hen zou kunnen helpen om zich aan een normaal eetpatroon te houden.

Aandachtsbias

Hoofdstuk 4 had tot doel om aandachtsprocessen voor voedsel in kaart te brengen bij overeters. Eerder onderzoek heeft laten zien dat mensen met disfunctioneel eetgedrag over het algemeen een verhoogde aandacht hebben voor voedsel (zie Dobson & Dozois, 2004; Faunce, 2002; Johansson, Ghaderi, & Andersson, 2005). In de huidige studie is gekozen voor de Exogene Cueing Taak (ECT), die bedoeld is om verschillende componenten van de aandacht te meten, namelijk vigilantie, het richten van de aandacht op een object en het loskoppelen van de aandacht van een object. In deze studie is onderzocht of overeters vooral de neiging hebben om hun aandacht te richten op vet voedsel en moeite hebben met de loskoppeling van de aandacht van vette voedselproducten. Bij deze ECT werden voedselplaatjes en neutrale plaatjes aangeboden gedurende 500 ms en 1500 ms om de aandacht te meten op verschillende tijdstippen van de aandacht. Als de plaatjes 500 ms werden aangeboden waren zowel de overeters als de controlegroep geneigd om vet voedsel te vermijden vergeleken met neutrale plaatjes. Als de plaatjes 1500 ms werden aangeboden lieten de overeters en de controlegroep geen verschil in aandacht zien voor voedsel of neutrale plaatjes.

Om de relatie tussen lijngedrag en de vermijding van de aandacht verder te onderzoeken, is er een correlationele analyse uitgevoerd voor de 500 ms conditie. Deelnemers die relatief hoog scoorden op disinhibitief eetgedrag (emotioneel en extern eten) lieten meer vermijding zien van vet voedsel en koppelden hun aandacht makkelijker los van voedsel. De neiging van overeters om vet voedsel te vermijden komt overeen met hun motivatie om voedselinname te beperken. Als overeters de aandacht echter wegrichten van voedsel raken ze misschien minder gewend aan de aanwezigheid van 'verboden' voedsel. Op de lange termijn zou deze strategie averechts kunnen werken, omdat overeters op deze manier onvoldoende leren om te gaan met de aantrekkelijke kenmerken van vet voedsel. Onder de 'juiste' omstandigheden (bv. sombere stemming, overmatige blootstelling aan voedselproducten of honger) zou juist deze groep van overeters wellicht verhoogde craving ontwikkelen, waardoor ze voedsel niet meer kunnen weerstaan.

Tenslotte is in Hoofdstuk 5 onderzocht of aandachtsbias voor voedsel ook een rol zou spelen bij beperkende AN-patiënten. Tot op heden is bij onderzoek naar aandachtsbias gekozen om geen onderscheid te maken tussen patiënten met boulimia nervosa (BN) en AN, terwijl deze groepen mogelijk juist verschillende aandachtspatronen laten zien. Het is bijvoorbeeld denkbaar dat BN-patiënten een verhoogde aandacht voor voedsel laten zien, terwijl AN-patiënten geneigd zijn hun aandacht af te wenden van voedsel. Verhoogde aandacht enerzijds en vermijding van de aandacht anderzijds zou kunnen helpen verklaren waarom BN-patiënten moeite hebben om geen eetbuien te hebben en AN-patiënten juist zo succesvol zijn in het beperken van hun voedselinname.

Net als bij de vorige studie (Hoofdstuk 4) werden er alleen effecten gevonden als de voedselplaatjes 500 ms werden aangeboden en lieten de deelnemers een patroon zien van het vermijden van de aandacht voor vette voedselproducten. Op grond van deze bevinding zijn er geen aanwijzingen dat aandachtsprocessen met betrekking tot voedsel betrokken zouden zijn bij disfunctioneel eetgedrag, maar lijkt het er meer op dat mensen in het algemeen geneigd zijn de aandacht van vet voedsel weg te richten.

Hier moet echter wel bij opgemerkt worden dat er bij een stimuluspresentatie van 500 ms meerdere aandachtsverschuivingen kunnen hebben plaatsgevonden en dat de neiging om de aandacht weg te richten van vet voedsel kan zijn gestuurd door meer bewuste, gecontroleerde processen (vgl., Field & Cox, 2008). Mogelijk zou een kortere aanbieding van de voedselplaatjes en de neutrale plaatjes (bv. 100 ms) wel leiden tot verschillen tussen groepen, omdat de aandacht op dit niveau meer automatisch is en minder gestuurd kan worden door strategische processen. Resultaten van een recente studie bieden ondersteuning voor deze veronderstelling en lieten zien dat obese mensen een sterkere aandachtsbias hadden voor voedselcues in vergelijking met mensen met een normaal gewicht (Nijs, Muris, Euser, & Franken, 2010). Verder is het mogelijk dat aandachtsprocessen alleen *via* andere processen vertekend worden, bijvoorbeeld via craving. Het verhogen van craving door honger, negatieve stemming of blootstelling aan voedsel zou mogelijk wel leiden tot vertekende aandachtsprocessen. Mogelijk leidt craving (of negatieve stemming, etc.) tot verhoogde aandacht voor voedselproducten in overeters (zie bv. Mogg, Bradley, Hyare, & Lee, 1998; Braet & Crombez, 2003; Hepworth, Mogg, Brignell, & Bradley, 2010). Dit type processen (b.v. negatieve stemming) zou er bij beperkende AN-patiënten wellicht juist voor kunnen zorgen dat ze de aandacht juist sterker gaan afwenden van voedsel, maar dit zal in de toekomst verder onderzocht moeten worden.

Conclusie

Om de vraag te beantwoorden waarom sommige mensen succesvol en sommige mensen falen in het reguleren van hun eetpatroon is in dit proefschrift gekeken naar drie verschillende cognitief-motivationele mechanismen, namelijk automatische motivationele oriëntatie voor voedsel, automatische affectieve associaties met voedsel en aandachtsbias voor voedsel. De belangrijkste uitkomst van dit onderzoek is dat automatische motivationele oriëntatie betrokken lijkt te zijn bij disfunctioneel eetgedrag. Op automatisch niveau laten overeters zien dat ze relatief sterk geneigd zijn om voedsel te naderen, terwijl beperkende AN-patiënten juist minder (geen) motivationele oriëntatie voor voedsel laten zien vergeleken met de controlegroepen. Automatische affectieve associaties met voedsel lijken niet betrokken bij disfunctioneel eetgedrag, maar mensen lieten over het algemeen wel sterkere positieve automatische affectieve associaties zien met vette voedselproducten in vergelijking met magere voedselproducten. Al met al is het patroon van bevindingen in overeenstemming met de zogenaamde ‘incentive-sensitization’ theorie, die stelt dat motivationele en niet zozeer affectieve processen van doorslaggevend belang zijn bij disfunctioneel eetgedrag.

Dankwoord

Tot slot wil ik iedereen bedanken die heeft bijgedragen aan het tot stand komen van dit proefschrift. Een aantal mensen wil ik daarbij speciaal noemen.

Allereerst Peter, dankjewel voor je onverbeterlijke enthousiasme en optimisme. Keer op keer verbaasde je me weer met jouw kijk op resultaten. Dankjewel dat je altijd klaar stond voor vragen en altijd tijd voor me nam. Ik heb veel van je mogen leren. Dankjewel dat je supersnel bent met het nakijken van manuscripten, wat je ondertussen beroemd heeft gemaakt als promotor!

En al mijn roomies over de jaren heen, Sippie, Johan, Madelon, Gemma en Helma en andere mede-AIO's, Corine, Femke, Maartje, Annemiek, Rineke, Klaske, Charmaine, Esther, Eva, Martine, Renate, Mariëtte, Gerard, Koen: dankjulliewel voor de gezelligheid en leuke gesprekken die we hebben gehad! Dankjulliewel voor ontzettend gezellige theetjes drinken, spelletjesavonden, congressen en EPP-symposia. Ik heb samen met jullie en de vaste staf een erg goede tijd mogen hebben op de afdeling.

En Sonja, door jouw visie voor het Centrum voor Eetstoornissen is dit project mogelijk gemaakt. Dankjewel daarvoor! En alle medewerkers van het Centrum voor Eetstoornissen van Accare: ik heb met veel plezier met jullie samengewerkt. Hoewel onderzoek eerst nog een apart onderdeel was binnen de afdeling is het in de loop van de jaren steeds meer een vast onderdeel geworden en maakt de evaluatiemeting nu een vast onderdeel uit van de behandeling. Ik vind het mooi om te zien dat onderzoek en praktijk hand in hand kunnen gaan!

En bedankt alle collega's en studenten die hebben meegewerkt aan dit project: Bert, Birte, Madelon, Nienke B., Laura, Josephine, Gea, Sandra, Annewieke, Nienke L. en Maike, bedankt voor het meedenken en/of testen van zoveel proefpersonen!

En alle cliënten die hebben deelgenomen aan het onderzoek: dank jullie wel dat jullie bereid waren deel te nemen en bedankt voor een kijkje in jullie levens. Ik ben onder de indruk geraakt van de heftigheid en complexiteit van jullie gedachten en gevoelens, wat een strijd hebben jullie te voeren! Gelukkig mocht ik van een heel aantal van jullie ook zien dat het beter mocht gaan in de loop van de tijd. Ik wens jullie veel sterkte met normaal (blijven) eten en positief naar jezelf kijken! Het is de moeite waard. Ik hoop van harte dat dit onderzoek in de toekomst mee mag helpen in de behandeling van eetstoornissen.

Gomarus College, bedankt voor de mogelijkheid om een controlegroep van middelbare scholieren bij jullie te mogen testen. De samenwerking met jullie verliep erg soepel en prettig, bedankt daarvoor!

En natuurlijk mijn lieve familie en vrienden, bedankt dat jullie altijd achter me stonden en me opvingen als het minder ging. En dat jullie soms zelfs de moeite namen om te begrijpen waar mijn project over ging! ;-)

En Darko, je zei laatst dat je ondertussen wel tot de 1% van Nederlanders zou behoren die het meeste van dit soort onderzoek af weet en daar heb je gelijk in! Dank dat je altijd weer naar me hebt geluisterd. En lieve Darko en lieve Sera, dank dat jullie me altijd weer aan het lachen maken. Jullie zijn mijn toppers.

Curriculum Vitae

Esther Veenstra werd geboren op 7 oktober 1982 in Eindhoven. In 2000 behaalde ze haar VWO diploma aan het Greijdanus College in Zwolle en ging ze psychologie studeren aan de Rijksuniversiteit Groningen. In augustus 2004 behaalde ze haar diploma in de richting Klinische Psychologie en Bioneuropsychologie. In mei 2005 startte ze met haar promotieonderzoek aan de Faculteit der Gedrags- en Maatschappijwetenschappen in Groningen, waar dit proefschrift het resultaat van is. Verder zette ze tijdens haar promotietraject een effectstudie op bij het Centrum voor Eetstoornissen van Accare in Smilde. In 2010 werkte ze een jaar als psycholoog bij Stichting Terwille, verslavingszorg.

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